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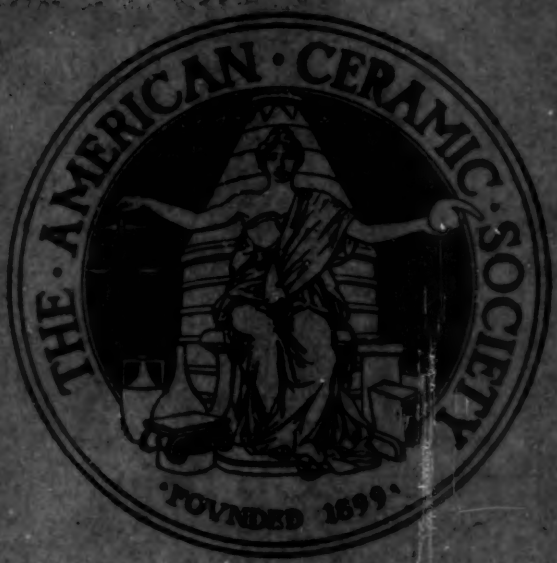

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ABSTRACTS
VOL. 12 No. 3

BULLETIN
VOL. 12 No. 3

VOLUME 16 MARCH · 1933 NUMBER 3

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Table of Contents

MARCH, 1933

The Journal

Thermal Conductivity of Magnesite Brick—Wilkes 125
Theory of Spalling—Preston 131
Terra Cotta Slip Coatings—McDowell 134
Conversion of Periodic Kilns from Coal Firing to Natural Gas for Firing Glazed Clay Products—Grady, Jr. 141
A Muffle Kiln of High Efficiency—Norton and Duplin, Jr. 152
Refining of Pacific Northwest Kaolins by Air Flotation—Wilson and Cunliffe 154

Ceramic Abstracts

89

The Bulletin

Editorial

Report of General Secretary Ross C. Purdy 59

Activities of the Society

Local Section News:

Pittsburgh Section 68
St. Louis Section 68

Ceramic Notes:

Iowa State College 69
Norton Company's New President 69
New Members Received in December, 1932, and January, 1933 70
Roster Changes in December, 1932, and January, 1933 70

Necrology:

F. W. Rogers 71
W. H. Zimmer 72
John M. Morton 73
Hermann Hecht 73

Notes and News

Industrial Research Laboratories 75
Home Ownership, Income, and Types of Dwellings 76
Have You Heard the Like of This Before? Do Not Ceramists Have This Same Problem? 77

Advertiser's Index 11

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THERMAL CONDUCTIVITY OF MAGNESITE BRICK*

By Gordon B. Wilkes

ABSTRACT

The thermal conductivity of magnesite brick has been determined from 200 to 2500°F with a new type of furnace and the results compared with previous experimenters.

I. Introduction

The determination of the thermal conductivity of magnesite brick is probably of greater general interest than that of any other refractory for two reasons, namely, the uncertainty of the actual value of the coefficient and the indication that the thermal conductivity decreases with rising temperatures, contrary to most refractory materials.

II. Previous Investigations

While a considerable number of determinations have been made within the past twenty years, the values of the coefficient vary at 1000°F between 8 and 39 B.t.u., hr.$^{-1}$, ft.$^{-2}$, inch, °F^{-1}. The lower value by Green[7] in 1921 indicates that magnesite brick conducts heat at about the same rate as fireclay brick while the higher value would show that it conducts heat about five times as rapidly as fireclay brick. The better known values determined since 1915 are shown graphically in Fig. 1.

The large difference in values is not due primarily to difference in chemical nature of the samples as shown in the accompanying table:

	MgO (%)	SiO_2 (%)	Fe_2O_3 (%)	CaO (%)	Al_2O_3 (%)	Volume density	True density	Porosity (%)
Dudley[1]	86.5	2.5	7.0	2.8	0.5	2.46		
Goerens and Gillis[2]	86.4	2.7	4.5		6.5	2.34	3.53	34
Dougill, Hodsman, and Cobb[5]	92.1	5.0	1.6	1.7	0.4	2.40	3.51	31.4
Norton[4]						2.42	3.54	31.6
Tadokoro[6]	76.4	18.3	0.8		2.6			
Van Rinsum[3]								
Green[7]	87.9		2.6	4.7		2.56	3.38	24.5
Wilkes	86.8	2.6	6.3	3.0	0.8	2.54	3.59	26–29

[1] B. Dudley, Jr., "Thermal Conductivity of Refractories," *Amer. Electrochem Soc.*, **27**, 285–328 (1915).

[2] Goerens and Gillis, "Über die Wärmeleitfähigkeit feuerfesten Steine," *Ferrum*, **12**, 1–17 (1914).

[3] Van Rinsum, "Die Wärmeleitfähigkeit von feuerfesten Steinen bei hohen Temperaturen sowie von Dampfrohrschützmassen und Mauerwerk unter Verwendung eines neuen Verfahrens der Oberflachentemperaturmessung," *Z. Ver. deut. Ing.*, **62**, 601–39 (1918).

[4] F. H. Norton, "Thermal Conductivity of Some Refractories," *Jour. Amer. Ceram. Soc.*, **10**, 30–52 (1927).

[5] Dougill, Hodsman, and Cobb, "Thermal Conductivity of Refractory Materials," *Jour. Soc. Chem. Ind.*, **34**, 464–71 (1915).

[6] Tadokoro, "Determinations of the Thermal Conductivity, Specific Heat, Density, and Thermal Expansion of Different Rocks and Refractory Materials," Tohôku Imp. Univ., *Sci. Rept.*, **10**, 339–410 (1921).

[7] A. T. Green, "Thermal Conductivity of Refractory Materials at High Temperatures," *Trans. Ceram. Soc.* [Eng.], **21**, 294 (1921).

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* Presented at the Annual Meeting, American Ceramic Society, Pittsburgh, Pa., February, 1933 (Refractories Division). Received November 5, 1932.

While Tadokoro used samples with relatively low MgO content, Dudley, Norton, and Wilkes used samples of magnesite brick of substantially the same analysis and manufactured by the same company.

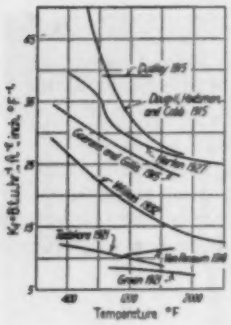


FIG. 1.—Thermal conductivity vs. temperature; results of previous investigations.

Green and Tadokoro used the well-known method of calculating the thermal conductivity, K, from the diffusivity and thus did not require thermal equilibrium nor an actual measurement of heat quantity, but it was necessary to know the specific heat and density. Their formula is given as follows:

$$\text{Diffusivity} = h^2 = \frac{K}{\rho C}$$

Where K = coefficient of thermal conductivity
ρ = density
C = specific heat

Van Rinsum used an electrically heated sphere with a spherical shell of refractory material surrounding the heater.

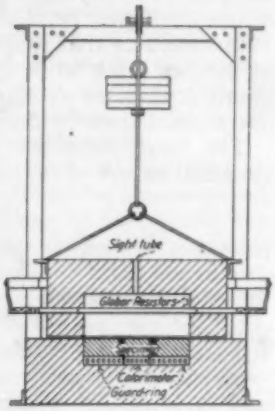


FIG. 2.—The apparatus.

The other experimenters used a water calorimeter with guard-ring to measure the heat quantity, with the exception of Dougill, Hodsman, and Cobb who measured the rate of heat-flow by the amount of water evaporated from a calorimeter surrounded by a guard-ring.

The direct measurement of the heat-flow, while difficult, has certain advantages over the other methods, especially with a material such as magnesite brick whose thermal conductivity changes rapidly with temperature. The chief source of error in measurements of this kind is the lack of proper guard-ring devices to insure a linear flow of heat through the specimen. This can only be determined by experiment and becomes increasingly difficult with better conducting materials and higher temperatures The method of temperature measurement is also somewhat doubtful in one or two cases but this should not be a serious factor.

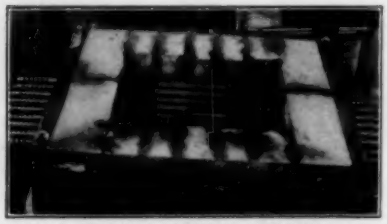


FIG. 3.—Globar furnace looking up from the bottom.

The fact that all of the investigators mentioned above also made determinations upon fireclay brick and agreed much more closely indicates that the various methods may have been satisfactory for fireclay materials with relatively low thermal conductivity but were not all satisfactory for a material such as magnesite brick. It is well known to those familiar with thermal conductivity measurements that different apparatus should be used for

different materials. For example, the standard plate method would not be used for a determination of the thermal conductivity of metals, although it is the best method known for insulating materials at relatively low temperatures.

III. Apparatus

The apparatus consisted of a well-insulated furnace inclosed on all sides except the bottom and heated with Globar resistance units so that a steady temperature could be maintained for hours up to a maximum of 2700°F. Water-cooling of the Globar holders was avoided by the use of nickel-chrome steel rods between the Globar units and perforated brass rods. The furnace was mounted in a sheet-iron case that was suspended by a wire cable and counterweighted so that the furnace could be readily raised and lowered. When the furnace was in the lowered position the bottom was formed by the test specimens which had an area equivalent to three standard 9-inch brick laid flatwise. Below the test specimens was a calorimeter, 3 by 3 inches, and this was in turn surrounded by a guard-ring calorimeter with outside dimensions of 9 by $13^1/_2$ inches. The calorimeters and test specimens were surrounded by several inches of insulation with the exception of the upper surface of the specimens (see Figs. 2, 3, and 4).

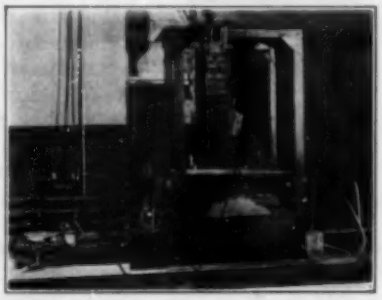


FIG. 4.—Complete apparatus as used.

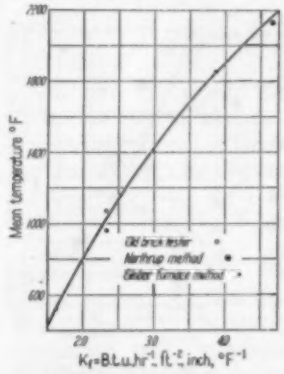


FIG 5.—Thermal conductivity of insulating brick by three different methods.

The calorimeter consisted of a copper plate, 3 inches square and $^1/_4$ inch thick, with a milled channel $^3/_{16}$ inch square, arranged so as to give a continuous passage for the water over the entire plate. A copper plate was soldered to the above plate, inclosing the water channel. Inlet and outlet were provided with suitable arrangements made to measure the temperature of the water either with mercury thermometers or multiple thermocouples. It is essential, with a calorimeter of this type, to have a source of water under constant head and thermostatically controlled temperature. The guard-ring was built in essentially the same manner as the calorimeter with a thin mica strip separating the two.

The temperature drop through the specimen was measured by means of thermocouples cemented in grooves cut in the surface of the brick. At very high temperatures the upper surface temperature was measured with an optical pyrometer in place of the platinum platinum 10%-rhodium thermocouple.

IV. Preliminary Tests

The apparatus was first tried out with high-temperature insulating brick and compared with two other methods used in this laboratory for determining the thermal conductivity of materials at high temperatures. It will be seen by Fig. 5 that the three methods agree rather closely and there is practically no question of the apparatus being adapted to insulating brick with a thermal conductivity of about 4 B.t.u., hr.$^{-1}$, ft.$^{-2}$, inch, °F^{-1}.

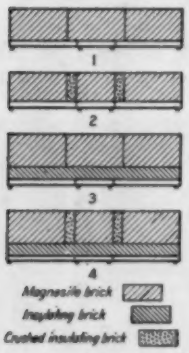


FIG. 6.—Four experimental conditions.

With a relatively good conductor of heat such as magnesite brick with a coefficient of thermal conductivity of possibly 25 or 30, a guard-ring, 3 inches thick did not seem sufficient. In order to check this possible error, a number of runs were made with a 3-inch square specimen separated from the guard-ring magnesite by $^3/_4$ inch of insulating powder.

A series of runs were made under each of the following conditions: (1) 3-inch square magnesite specimen with magnesite guard-ring; (2) 3-inch square magnesite specimen, $^3/_4$-inch insulating powder and magnesite guard-ring; (3) same as No. 1 with one inch of insulating brick between calorimeter and the magnesite; and (4) same as No. 2 with one inch of insulating brick between calorimeter and the magnesite.

Tests Nos. 2 and 4 (see Fig. 6) showed consistent results and agreed with each other. Number 3 was the poorest and evidently indicated insufficient guarding. Number 1 was better than No. 3 but it still indicated poor guarding.

The insulating brick was placed below the magnesite in order to produce high mean temperatures in the sample.

In view of these preliminary tests, it was decided to use for a test specimen a block cut from the brick that was 3 inches square and $2^1/_2$ inches thick. This block was surrounded by a layer of crushed kaolin insulating brick $^3/_4$ inch in thickness, and outside of this layer was sufficient magnesite brick to cover the guard-ring calorimeter.

V. Results

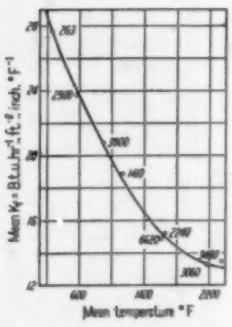


FIG. 7.—Effect of temperature gradient on thermal conductivity.

Eight runs were made on magnesite-brick samples with the mean temperatures varying from 250 to 2350°F and with hot surface temperatures ranging up to 2700°F. These tests were plotted on a chart of mean K_f *versus* mean temperature as shown on Fig. 7. It has been often mentioned that with relatively good conductors of heat, the thermal conductivity may vary with rate of heat-flow or temperature gradient as well as with temperature. In these tests the rate of heat-flow was varied between 263 B.t.u., hr.$^{-1}$, ft.$^{-2}$ and 6620 B.t.u., hr.$^{-1}$, ft.$^{-2}$ and yet there is no indication of any appreciable variation of the thermal conductivity with rate of heat-flow.

From the curve of mean K_f *versus* mean temperature, the true K_f at temperature t was calculated using the equation

$$\text{True } K_f = a + bt + ct^2 \qquad (1)$$

Where a, b, and c = constants
t = temperature °F

Taking any one test point on the mean temperature curve, the following relation holds:

$$\text{Mean } K_f\,(t_2 - t_1) = \int^{t_2} \text{true } K_f\,dt = \int_{t_1}^{t_2} (a + bt + ct^2)dt \qquad (2)$$

By taking three such points, the simultaneous equations for the values of a, b, and c can be solved.

For magnesite brick, the following relation was found between the true K_f and temperature t.

$$K_f = 31.8 - 14.4 \times 10^{-3}\,t + 2.66 \times 10^{-6}\,t^2.$$

In order to use this value of thermal conductivity in determining the heat-flow through a wall with surface temperatures of t_2 and t_1, it would be necessary to determine the mean K_f between the temperatures t_2 and t_1 by using equation (2). The calculation becomes much simpler if one plots mean K_f between 0°F and t°F. The mean K_f between any two temperatures t_2 and t_1 may then be found by the following equation:

$$\text{Mean } K_f = \frac{K_2 t_2 - K_1 t_1}{t_2 - t_1} \qquad (3)$$

K_2 and K_1 would be taken from the chart at temperatures t_2 and t_1, respectively.

Curves showing the true coefficient of thermal conductivity of magnesite brick at various temperatures up to 2500°F and the mean coefficient between 0°F and t°F are shown in Fig. 8.

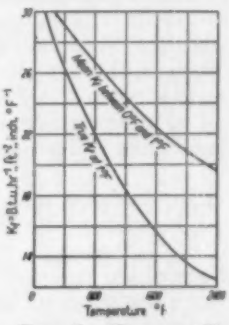


FIG. 8—True coefficient of thermal conductivity *vs.* temperature and mean coefficient between 0°F and t°F.

VI. Conclusions

An apparatus has been devised that is suitable for thermal conductivity measurements on refractories up to a maximum temperature of 2700°F and with coefficients of thermal conductivity at least as high as that of magnesite brick.

The evidence is quite conclusive that the thermal conductivity of magnesite brick decreases with increasing temperatures over the range considered.

There is no evidence that the thermal conductivity of magnesite brick varies with the rate of heat-flow or temperature gradient. This conclusion is based on inspection of Fig. 7, in which the mean K_f (thermal conductivity) is plotted against mean temperature. There are eight runs on this plot and after each point is placed a figure indicating the rate of heat-flow for that particular point. The rates of heat-flow vary from 263 to 6620 B.t.u., hr.$^{-1}$, ft.$^{-2}$ and are scattered rather hit or miss over the curve.

If rate of heat-flow did affect the coefficient of thermal conductivity, one would find the very low rates on one side of the curve and the very high rates on the other side of the curve. This is not the case and consequently there is no evidence to indicate that thermal conductivity varies with rate of heat-flow over this experimental range which covers the majority of cases met in practice.

The chief source of error with calorimetric methods is probably the lack of suitable guard-rings.

Division of Industrial Coöperation and Research
Massachusetts Institute of Technology
Cambridge, Massachusetts

THEORY OF SPALLING*

By F. W. Preston

ABSTRACT

This paper registers objection to the purely mathematical parts of F. H. Norton's treatment of the subject. The physical nature of the spalling process will be dealt with later.

In this *Journal* some years ago F. H. Norton[1] contributed an article on "A General Theory of Spalling." It was a courageous attempt on a not too simple subject, but the mathematical work was faulty and the physical concepts unsound. The present writer so reported to Mr. Norton,[2] and at his suggestion a year or so later published a brief comment and criticism.[3] That comment besides criticizing the mathematics, took the stand that spalling fractures are *tensile* fractures, not *shear* fractures. Mr. Norton conceded[4] that this last point was true of the fracture originally envisaged by him, *viz.*, those due to sudden *quenching*, but adduced evidence which in his opinion tended to show that fractures produced by sudden *heating* were *shear* fractures.

The present writer has not accepted this evidence, and does not now accept it. He has in this *Journal* and elsewhere at various times shown that all fractures (in *glass* at any rate) are tensile in origin.[5] He will, in the not distant future, re-interpret Mr. Norton's sudden-heating fractures and show that they are tensile in origin, and give a new "general theory of spalling"; but not now. The present paper is concerned solely with the mathematics of elastic stresses, not with the physics of crack formation.

The present paper is provoked by the appearance of Mr. Norton's book on refractories,[6] in which his old theory appears. The treatment is in no way different from the original paper, except that there are a few additional misprints.

Reduced to bare facts, the mathematical part of that original paper does not really deal with spalling, but with the stresses produced by sudden quenching (or sudden heating).

The supposition there advanced is that when a certain *shear* is exceeded the refractory will spall. The paper therefore sets out to calculate what shear stress is produced by a sudden change of temperature in a given refractory.

Without conceding that spalling has anything to do with shear, it is necessary to state once more that the mathematics is wrong. Mr. Norton's assumptions are not sufficient to prove the existence of any stress of any kind: the treatment is incorrect and the answer wrong.

The fundamental assumption in the original paper seems to be that a temperature gradient in a brick will produce stresses in the brick. This is

---

* Revised copy received November 28, 1932.

[1] F. H. Norton, "General Theory of Spalling," *Jour. Amer. Ceram. Soc.*, **8** [1] 29–39 (1925).

[2] Private communication.

[3] F. W. Preston, "Spalling of Brick," *Jour. Amer. Ceram. Soc.*, **9** [10], 654–58 (1926).

[4] F. H. Norton, "Mechanism of Spalling," *ibid.*, **9** [7], 446–61 (1926).

[5] *Jour. Soc. Glass Tech.*, **10**, 234–69 (1926); *Jour. Amer. Ceram. Soc.*, **14** [6], 419–27 (1931); *Proc. Roy. Soc.*, **106B**, 88–93 (1930).

[6] F. H. Norton, Refractories.

not the case. If the gradient be uniform throughout the thickness of the brick (or slab), the slab will simply bow to part of a circle or sphere, and no stresses will be set up. Every fiber or element of the refractory can, by this bowing, expand or contract to the length proper to its own temperature, and under these conditions no stress is set up.

In order to set up a stress at all, the gradient through the slab must be nonuniform. It is the inequalities of the temperature gradient from place to place, not the mere existence of a temperature gradient, that set up stresses.

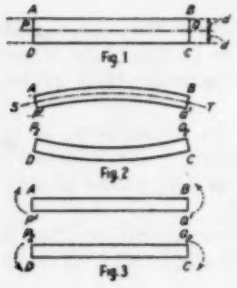
Neither the original paper nor the book says anything, in the mathematical section, about any part of the slab except the lamina isolated for consideration. We, therefore, do not know explicitly whether there is any stress in this isolated piece at all. The particular thermal gradient is consistent with any stress or system of stress whatever, or with the complete absence of stress.

We must therefore make some further assumption: the simplest we can make, and the one that may be held to be implicit in the original paper, is that the sudden heating or cooling leaves plane sections plane; that is, there is no bending or bowing of the brick. We do not need to specify the thermal gradients at remote parts of the brick for this purpose, but merely require that they be of any character that will meet this specification.

The Mathematical Considerations

This will enable us to say that stresses *do* exist, and to make some general observations about them. Without some further assumption, the stresses in the area under isolated study can not, however, be completely calculated. It can, however, be shown that they will *not* be what Mr. Norton calculates.

The simplest case we can take that will meet Mr. Norton's explicit and implicit assumptions, is as follows: Let $ABCD$ be a section through a slab, AB being one face and CD the other. For preference, let the slab extend to a great distance sideways beyond AD and BC.



Let PQ be the plane of symmetry, half-way between AB and CD.

Let there be a uniform temperature gradient from AB to PQ and an equal but opposite temperature gradient, also uniform, from PQ to DC; so that AB and CD are at temperature θ_1, and PQ is at temperature θ_0. The temperature gradient above PQ is $(\theta_1-\theta_0)/d$ degrees per inch of thickness, and below this it is $-(\theta_1-\theta_0)/d$.

Separate the two halves of the slab along the plane PQ by any means, and the two halves will bow as in Fig. 2. They will then be completely free from stress.

A plane ST, half-way between AB and P^1Q^1, will have the same length measured along the curve as it had in Fig. 1. AB will become longer than the AB of Fig. 1; PQ will have become shorter.

The two halves may be restored to flatness by imposing a uniform bending moment on them (Fig. 3).

By a uniform bending moment we mean one that is of equal value at any

vertical section as we go from *A* to *B*. Such a bending moment is characterized by the fact that it bends a specimen, originally flat, into a truly circular arc, or beginning with a truly circular arc, will bend it back to a true flat. The bows of Fig. 2, arising from a temperature gradient which is everywhere equal as we go from *A* to *B*, will be true circles, so a uniform bending moment of appropriate amount can restore the parts to perfect flatness.

The two halves in Fig. 3 now have exactly the same temperature gradients and exactly the same shape as they have in Fig. 1. They will, therefore, have exactly the same distortions or strains, and exactly the same stresses.

But it is proved in textbooks that a uniform bending moment, one that does not vary from section to section as we go along the beam, produces no shear, that is, no shear on horizontal or vertical planes; and this is what Mr. Norton set out originally to calculate.

It is true that in his book Mr. Norton, after calculating numerically, but incorrectly, what happens on horizontal planes, has added the remark that the shear really occurs on planes at 45°, to which he adds the further very remarkable note, that "this does not affect the argument." This is about as logical as a sea-captain who should feel a great interest in the distance to port, but holds that it is immaterial in what direction he steers.

(1) The Shear at 45° The shear at 45° can not, of course, be calculated by Mr. Norton's method at all. It can be found, in the simplest way, by the formula which states that it is half the (algebraic) difference of the two principal stresses. The principal stresses, acting on horizontal and vertical planes, bear no simple relation to Mr. Norton's figurings. They may be found approximately from the simplified assumption we have given above, or more accurately from the work of Adams and Williamson[7] or other impressive treatises. And from these the shear stresses at 45° could be found if anybody wanted them.

(2) Stresses Do Not Vary Directly with Size of Specimen It will, among other things, be found that neither the principal stresses nor the shears vary directly with the size of the specimen. In fact, if the specimen is large compared with the depth of penetration of the heat, the stresses vary little from point to point (over a plane at a given depth below the surface).

The introduction of the size of the specimen into the argument arises from the false premises of the paper. It persists in the final formula, and though camouflaged by being finally lumped in with a number of other quantities into a general "constant," it is still there and of course renders invalid Mr. Norton's comparison of his own formula with that of Winkelmann and Schott (p. 352 of the book). The two formulas are not dimensionally similar, and can no more be compared than a length and an area.

The Winkelmann and Schott formula may be used by ceramists with the assurance that at any rate it looks right.

Acknowledgment The author wishes to take this opportunity to thank H. E. White and D. E. Parsons for their assistance and comments.

BUTLER, PA.

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[7] *Jour. Franklin Inst.*, **190**, 597, 835 (1920); E. D. Williamson, *Jour. Wash. Acad. Sci.*, **9**, 209 (1919).

TERRA COTTA SLIP COATINGS*

By Samuel J. McDowell

ABSTRACT

Compositions in the high clay area of the triaxial, feldspar, clay, Cornwall stone, were studied as slip coatings for a terra cotta body. Calcined English ball clay was used to introduce a portion of the clay content. The porosity, checking behavior, tendency to craze in the autoclave, and the relative compression of the slips are shown. A typical desirable slip was chosen and the effect of additions of various fluxes and coloring oxides was studied. Slips of this type seem to offer the terra cotta industry the possibility of vitreous slips with greater resistance to moisture crazing.

I. Introduction

There is some misunderstanding of the term "slip coating" or "slip" outside of the terra cotta industry. For this reason it should be explained that this article covers work on the thin, porcelain-like coating, sprayed on one-fire terra cotta where a "standard slip" or nonglazed surface is desired. The coating should be vitreous, should not check, and at the same time should fit the body so that crazing will not occur.

The colors desired in slip coatings are most often those matching various types of brick and natural stone. They are usually white, gray, buff, or red in various shades. It would seem desirable to study first the white slip coating and choose one with desirable physical properties. With this as a master slip various shades can be obtained by the addition of ceramic colorants. In this way the effect of each colorant on the master slip can be studied.

Note: It should be remembered that this work was conducted upon a single terra cotta body. There appear, however, to be certain points brought out which might be of general interest and which could be used as a background for future work by those in the same field using other bodies.

II. Review of Literature

The presence of potters flint in slip coatings is apparently undesirable from a crazing standpoint,[1a,b] and the triaxial, feldspar, clay, and Cornwall stone, appears to be the most promising starting point for this investigation. This field has been investigated in part by Davis and Lathrop[1a] and by Hill.[2] The conclusions reached by each, showed that an increase in the clay content tended to overcome crazing, but further investigation in this direction was not carried out because the slips showed increased porosity and checked badly.

In the porcelain field increased strength, elasticity, and resistance to heat shock are obtained in chemical and spark-plug porcelain. Some bodies of this type have a very high clay content. Eighty or ninety per cent can be used if that portion above the requirements for workability is calcined

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* Presented at the Annual Meeting, American Ceramic Society, Pittsburgh, Pa., February, 1933 (Terra Cotta Division). Received December 2, 1932.

[1a] H. E. Davis and J. S. Lathrop, "Study of Slips for Standard Finish Terra Cotta," *Jour. Amer. Ceram. Soc.*, **8** [1], 23 (1925).

[1b] R. T. Stull, "Notes on Manufacture of Enameled Brick with Some Investigations on Enameled Brick Slips," *Trans. Amer. Ceram. Soc.*, **12**, 711 (1910).

[2] E. C. Hill, "Some Experiments on Terra Cotta Slips," *Jour. Amer. Ceram. Soc.*, **11** [4], 260 (1928).

and ground. It was felt that this principle might be used to advantage in producing better slip coatings if a clay could be found which vitrified below the terra cotta firing temperature and had a long firing range.

Sortwell[3] showed that few, if any, American ball clays vitrified at cone 7 and this was borne out by Wilson[4] who used calcined Tennessee ball clay and found that the resultant slips were very porous. On the other hand several of the English ball clays tested by Sortwell were practically vitreous as low as cone 2 and were not overfired at cones 10 or 12. Fayles ball clay was one of these and was chosen for this work.

III. Procedure

(1) Raw Materials The ball clay used was imported by the Paper Makers Importing Company, the Connecticut feldspar and wet ground Cornwall stone, from the R. & H. Chemical Company, and the Canadian feldspar, from the Consolidated Feldspar Corporation.

Typical analyses are as follows:

	Cornwall stone	Connecticut feldspar	Canadian feldspar
Ignition loss	2.0		
SiO_2	72.03	72.2	68.0
Al_2O_3	18.0	17.9	18.6
Fe_2O_3	Trace	0.17	0.2
CaO	1.25	0.1	0.2
Na_2O	0.5	3.0	3.5
K_2O	7.0	6.2	8.5

(2) Body These experiments were made on a commercial terra cotta body having an absorption of less than 10% after 5 hours' boiling when it had been fired to cone 7 down. The linear shrinkage was 3.7% from the dry to fired state at cone 7 down.

(3) Test Pieces The test pieces were tile 2 by 4 by $^5/_8$ inch and rings 4 inches in diameter (Fig. 1). The rings were sprayed on the outside only and were similar to those suggested by Schurecht and Pole[5] and Davis and Lueders,[6] except that they were larger and readings were made directly to the nearest 0.0005 inch with a micrometer caliper. Care was taken in spraying to get the same thickness of slip on each test piece. A bar 4 by 1 by $^1/_4$ inch was also cast from each of the various slips.

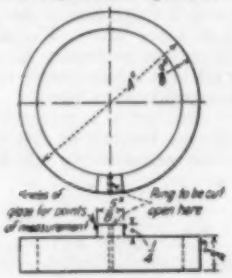

FIG. 1.

IV. Preliminary Work

The ball clay was dried, crushed through 8-mesh, and fired to 800°C. At this temperature it was friable and devoid of plasticity. This was used in two series with domestic clays, feldspar, and Cornwall stone. The

[3] H. H. Sortwell, "American and English Ball Clays," Bur. Stand., *Tech. Paper*, No. 227.

[4] Hewitt Wilson, "Notes on Terra Cotta Slips with Reference to the Use of Asbestos and Chlorite Mica," *Jour. Amer. Ceram. Soc.*, **3**, 114 (1920).

[5] H. G. Schurecht and G. R. Pole, "Method of Measuring Strains between Glazes and Ceramic Bodies," *ibid.*, **13** [6], 369 (1930).

[6] H. E. Davis and R. L. Lueders, "Simplification of the Ring Method for Determining Glaze Stresses," *ibid.*, **15** [1], 34 (1932).

results were negative as far as satisfactory slip coatings were concerned. They were too porous and there was a great deal of checking. It was definitely proved, however, that high clay slips were under higher compression than those low in clay when fired to the same temperature and the direction for future work was clearly indicated.

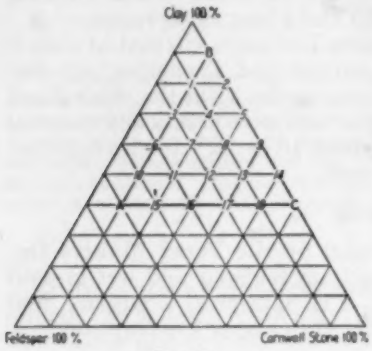

FIG. 2.

(1) Triaxial A, B, and C Figure 2 shows the position of this field in relation to the triaxial, clay, feldspar, and Cornwall stone. The ball clay was treated as before and calcined to cone 7 down. At this temperature it was practically vitreous. The end members A, B, and C were made up as follows:

Materials	A	B	C
Connecticut feldspar	25		
Canadian feldspar	25		
Cornwall stone	10	10	60
English ball clay (raw)	40	40	40
Sodium carbonate	1	1	1
English ball clay (calcined cone 7)		43*	
Total	101	94	101

* This corresponds to 50% raw clay.

NOTE: The calcined clay was ground wet for three hours in an 18- by 24-inch ball mill. The remainder of the charge was then added and ground for one additional hour. For those batches containing no calcined clay the entire charge was added at once and ground three hours. All slips were screened through 80-mesh and each weighed 1470 grams per liter. The intermediate members were blended by volume and each test piece was uniformly sprayed with four coats of slip. The remainder of each slip was cast into a bar 4 by 1 by $^1/_4$ inch. Two unsprayed rings were included at each firing temperature as blanks.

One set of test pieces was fired to cone 8 half-down in 125 hours and a duplicate set to cone 6 down in 129 hours. These temperatures represent the maximum and minimum variations in kiln firing. Both firings were made in a 14-foot commercial kiln.

V. Testing

The rings were carefully measured between the knobs of glaze with a micrometer caliper and each reading checked. The rings were then sawed open between the points of measurement and the micrometer reading taken again and checked. The difference in the readings, which was the amount of movement of the ring after being sawed open, was a measure of the relative compression of the slip. The unsprayed rings which were run as checks showed in two cases 0.000 inch change, in the third, 0.0005 inch, and in the fourth, 0.001 inch. It is felt therefore that this method has a probable accuracy of ± 0.001 inch. Schurecht and Pole[7] have shown that slips under high compression (short of the shivering point) are more resis-

[7] See footnote 5.

tant to moisture crazing or that type of crazing which develops after long exposure to weather.

The tile test pieces were placed in an autoclave and the steam pressure raised to 150 pounds per square inch in one hour. This pressure was held for one hour when it was released and the autoclave opened.[8] When the

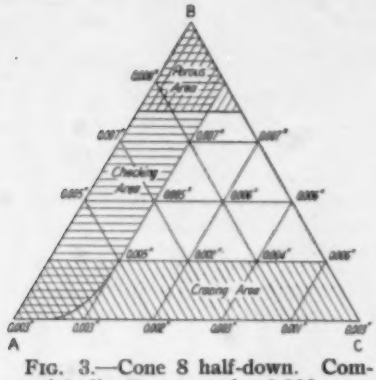

FIG. 3.—Cone 8 half-down. Commercial slip D was under 0.002 compression and was slightly crazed.

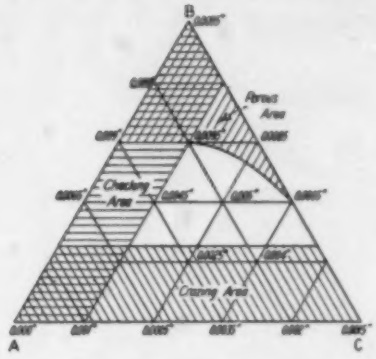

FIG. 4.—Cone 6 down. Commercial slip D was under 0.002 tension and was crazed.

tile were cool they were painted with an alcoholic solution of dye. This was washed off when dry and the craze marks, checks, and porosity of each slip coating noted.

The slip cast trials were measured for shrinkage, then soaked in an alcoholic dye solution for twenty-four hours, broken, and the porosity noted by the dye penetration.

VI. Results

Figures 3 and 4 show the tendency of the slip coatings to check, the porosity, and the tendency to craze from the autoclave treatment. They also indicate the relative compression of the slips in inches as shown by the ring tests at the two temperatures. Results of tests on commercial slip D are shown for comparison.

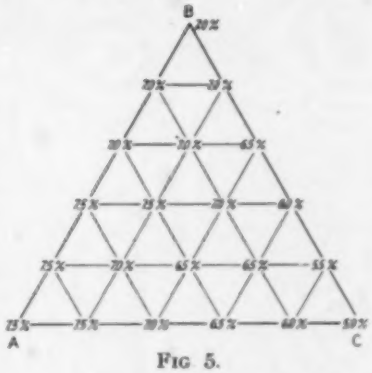

FIG. 5.

Figure 5 shows the percentage linear shrinkage of the cast bars of each of these compositions, from the dry to fired state at cone 8 half-down. The results for the cone 6 firing were similar and are not given. It is interesting to note that a high clay slip such as No. 4 has the same linear shrinkage as a low clay slip such as No. 16, but the former is under much greater relative compression than the latter. It will be noted also that high clay slips having a linear shrinkage of 7% in the cast state *are under*

[8] H. G. Schurecht, "Methods for Testing Crazing of Glazes Caused by Increase in Size of Ceramic Bodies," *Jour. Amer. Ceram. Soc.*, 11 [5], 271 (1928).

high compression on a terra cotta body having a linear shrinkage of 3.7%. This indicates that the physical properties of a thin coating are different from those of a cast bar of the same composition. It leads one to question the results obtained for the physical properties of glazes when they are studied in the glass rod state. The entire triaxial was vitreous as tested by the bars and these are apparently less sensitive to dye absorption than are slips of the same composition (see Fig. 3).

VII. Further Work

Slip No. 4 was chosen as the most practical basis for future work. It was on the edge of the checking area but this was believed to be partly caused by faulty application. It was also on the edge of the porous area, but since the fluxes and coloring oxides to be added would increase vitrification, this was not regarded as serious. It was safely away from the moisture crazing area and was under a high relative compression.

The batch weight of this slip is as follows:

Connecticut feldspar	5	English ball clay (calcined)	25.8
Canadian feldspar	5	Sodium carbonate	1.0
Cornwall stone	20		
English ball clay (raw)	40	Total	96.8

The slip as used weighed 1520 grams per liter and contained 54.3% dry material. In each series this was used as one end member; the other was No. 4 slip to which had been added either a flux or a coloring oxide. Intermediate mixtures were blended by volume, and rings and tile were sprayed as before. One set was fired to cone 6 down in 144 hours, and the second to cone 8 half-down in 132 hours. The pieces were tested as before.

TABLE I. RESULTS OF TESTS (cone 6 down)

Slips	4	G	H	I equals No. 4 + 3% 100-mesh mica stirred into slip
Compression (in.)	0.009	0.010	0.006	0.0055
Autoclave test	O.K.	O.K.	O.K.	O.K.
Porosity	Slightly porous	Slightly porous	Porous	Porous

Slips	4	K	L	M	N equals No. 4 + 2% whiting ground 2 hr.
Compression (in.)	0.009	0.008	Broken	0.007	0.011
Autoclave test	O.K.	O.K.	O.K.	O.K.	O.K.
Porosity	Slightly porous	Slightly porous	O.K.	O.K.	O.K.

Slips	4	O	P	Q	R equals No. 4 + 0.8% ZnO ground 2 hr.
Compression (in.)	0.009	0.005	0.0035	0.002	Broken
Autoclave test	O.K.	O.K.	Slightly crazed	Slightly crazed	Crazed
Porosity	Slightly porous	Slightly porous	O.K.	O.K.	O.K.

Slips	4	S	T	U	V equals No. 4 + {5% Fe_2O_3 / 5% bone ash ground 2 hr.
Compression (in.)	0.009	0.009	0.008	0.011	Broken
Autoclave test	O.K.	O.K.	O.K.	O.K.	O.K.
Porosity	Slightly porous	Slightly porous	O K.	O.K.	O.K.

TABLE I (*Continued*)

Slips	4	W	X	Y equals No. 4 + 2% coarse MnO_2 ground 2 hr.
Compression (in.)	0.009	0.013	0.014	0.016
Autoclave test	O.K.	O.K.	O.K.	O.K.
Porosity	Slightly porous	Slightly porous	O.K.	O.K.

(Cone 8 half-down)

Slips	4	G	H	I equals No. 4 + 3% 100-mesh mica stirred into slip
Compression (in.)	0.006	0.005	0.004	Broken
Autoclave test	O.K.	O.K.	O.K.	O.K.
Porosity	Slightly porous	Slightly porous	Slightly porous	Slightly porous

Slips	4	K	L	M	N equals No. 4 + 2% whiting ground 2 hr.
Compression (in.)	0.006	0.005	Broken	0.0065	0.0055
Autoclave test	O.K.	O.K.	O.K.	O.K.	O.K.
Porosity	Slightly porous	O.K.	O.K.	O.K.	O.K.

Slips	4	O	P	Q	R equals No. 4 + 0.5% ZnO ground 2 hr.
Compression (in.)	0.006	Broken	0.002	0.0015	0.002 tension
Autoclave test	O.K.	O.K.	O.K.	Crazed	Badly crazed
Porosity	Slightly porous	O.K.	O.K.	O.K.	O.K.

Slips	4	S	T	U	V equals No. 4 + 5% Fe_2O_3 + 5% bone ash ground 2 hr.
Compression (in.)	0.006	0.0045	0.008	Broken	0.0065
Autoclave test	O.K.	O.K.	O.K.	O.K.	O.K.
Porosity	Slightly porous	Slightly porous	O.K.	O.K.	O.K.

Slips	4	W	X	Y equals No. 4 + 2% coarse MnO_2 ground 2 hr.
Compression (in.)	0.006	Broken	0.008	0.011
Autoclave test	O.K.	O.K.	O.K.	O.K.
Porosity	Slightly porous	O.K.	O.K.	O.K.

VIII. Conclusions

It must be borne in mind that this was a plant investigation and the results for the ring tests were not checked at each temperature. When the results of experiments fired at different temperatures showed, however, a definite trend it seemed logical to draw the following conclusions:

(1) From a comparative study of slip coatings in the cast bar state and on a terra cotta body, it is indicated that the physical properties are very different. This leads one to question the application to glazes of physical properties of glass rods of the same composition.

(2) Using a high clay content with a portion of the clay calcined, satisfactory slip coatings can be produced at cone 7. These are vitreous and at the same time resist moisture crazing. They are under a high relative compression and should be extremely weather resistant.

(3) Additions of mica to slips of this type tend to increase the porosity and slightly lower the compression.

(4) Additions of whiting up to 2% seem to have little effect upon compression and make the slip more vitreous.

(5) Additions of zinc oxide lower compression markedly and cause crazing.

(6) Additions of iron oxide and bone ash up to 5% each have little effect on compression. They increase vitrification.

(7) Additions of manganese dioxide up to 2% greatly increase the compression. This is unusual in its effect and it is probably fortunate that so many of the terra cotta slips contain this material. It also increases vitrification.

The colors developed were not satisfactory, although those containing manganese dioxide were passable. It is believed, however, that by further experimentation a group of pleasing colors can be developed.

This work did not cover the field at all completely, but it is hoped that it may prove a background for future work which will give the industry more weather-resisting vitreous slip coatings.

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CONVERSION OF PERIODIC KILNS FROM COAL FIRING TO NATURAL GAS FOR FIRING GLAZED CLAY PRODUCTS*

By Robert F. Grady, Jr.

ABSTRACT

This paper describes in detail the operation of a pressure system as applied to open-fired round periodic kilns, using natural gas as a fuel. A comparison is made between this system and other more prominent types of kilns and their equipment.

I. Introduction

A terra cotta company recently found it necessary to reduce the time and cost of its firing operations. The following paper describes the results of a comprehensive study and personal inspection of all of the better-known types of kilns and kiln equipment adaptable to the requirements of this plant.

Natural gas as a fuel was favorably considered provided means could be found to compensate its high cost per heat unit. A gas open-fire pressure firing system replaced coal firing as a result of this study. In the description of its operation will be seen the good points of nearly all kiln systems.

II. Properties of Natural Gas

Natural gas is a mixture of several paraffin hydrocarbons diluted with varying amounts of nitrogen and oxygen. These gases usually occur along with or in the proximity of the oil-producing fields of the United States. The majority of these natural gases have a high heating value, ranging from 950 to 1150 B.t.u. per cubic foot with a specific gravity of 0.57 to 0.65, using air as the basis of comparison.

Gas Analysis of Mississippi River Fuel Corporation's Natural Gas†

Gas	Per cent	B.t.u./ cu. ft.	Specific gravity	B.t.u.	Calculated specific gravity
CO_2	0.60		1.5291		0.0091746
Ill.	0.35	1639.0	0.9749	5.7365	.0034121
O_2	0.20		1.1052		.0022104
H_2	0.10	326.7	0.0695	0.3267	.0000695
CO	0.20	338.0	0.9672	0.6760	.0019344
C_2H_6	3.58	1792.0	1.0492	64.1536	.0375774
CH_4	90.77	1023.0	0.5543	928.5771	.5031381
N_2	4.20		0.9722		.0408324
Total	100.00			999.4699	0.5983489

B.t.u. determined on calorimeter, 998.9.
B.t.u. calculated, 999.4.
Specific gravity determined on gravity balance, 0.614.
Specific gravity calculated, 0.598.

† St. Louis, Mo., June 12, 1932.

The typical natural gas has an extremely low sulfur content and little or no moisture. Low sulfur content is required and low moisture content

* Presented at the Annual Meeting, American Ceramic Society, Pittsburgh, Pa., February, 1933 (Terra Cotta Division). Received November 11, 1932.

permits its transportation with no more difficulty during the colder than in the warmer seasons and eliminates the possibility of frozen gas lines.

Natural gas differs from most manufactured gases not only in its specific gravity and heating value, but also in the amount of air necessary for its perfect combustion. The typical natural gas requires about ten volumes of air for each volume of gas burned, while manufactured gas requires from two to six volumes of air per volume of gas burned.

NOTE: The majority of the natural gas distributing companies have been successful in preventing the various states from classifying them as public utilities. As a result they have not been subjected to any price regulation by the various state regulating agencies. Due to this lack of regulation the selling price for industrial uses varies from a few cents per 1000 cubic feet up to fifty cents per 1000 cubic feet. The selling price of gas seems to be based on the selling price of competing fuels, fuel oils in particular, rather than the expense of transportation and the volume of the available supply.

III. Classes of Periodic Kilns

In any discussion of periodic kilns for firing glazed ware, attention is drawn immediately to open fire and muffle kilns. It is the muffle kiln that is used most largely for terra cotta firing.

In muffle kilns the products of combustion are not supposed to come into contact with the ware, but pass around and through the kiln within the flues. The gases give up heat to the flue walls and from them, by radiation, convection, and conduction, to the ware. The design of the flue system varies from kiln to kiln, kilns from any two plants seldom acting alike.

The portion of the kiln occupied by the ware, being vented to the air, is under a negative static pressure throughout the firing period. The "muffle" of a kiln is therefore not truly a muffle but a leaky curtain wall through which the products of combustion filter into the setting. This leaking of combustion products into the ware can be prevented by maintaining in the flues a higher negative pressure than in the muffle chamber. Theoretically this is possible, but in practice it is seldom accomplished. The pressure in the fire boxes and in the external stack are highly negative in value but in the flue system the static pressure usually is positive due to obstructions in the flues and to the intricate passages through which the gases must travel.

When the pressure is positive or even less negative in the flues than it is inside the muffle, the combustion gases will pass into the muffle due to this difference in pressure. They circulate around the ware and are finally discharged through the muffle vents.

By the time the gases have passed out of the muffle chamber they have done their damage. The portions of the flue system which are more positive in pressure than the muffle chamber are shown by localized areas of blistering and flashing from which the products fired in a muffle kiln are never free.

In the combustion of coal the formation of carbon monoxide at times takes place even in the presence of an excess of air. This has been demonstrated in gas analyses on kilns, boilers, and, in fact, all furnaces where coal is being used as a fuel. The presence of this carbon monoxide and sulfurous gas, derived from coal, causes the damage that results from leaky muffles.

IV. Fundamental Types of Gas Burners

(1) Burners designed to use the kinetic energy of the gas to entrain the necessary air for proper combustion, (*a*) single and compound high-pressure gas burners, (*b*) atmospheric burners.

(2) Burners designed to use the kinetic energy of an air stream to entrain the necessary gas for proper combustion. This type of burner is equipped with a regulator for reducing the gas pressure at the burner to atmospheric pressure. The gas at atmospheric or zero pressure is inspirated into the air stream due to the design of the mixing chamber of the burner. Such equipment is usually designed for single-valve control as the air-gas ratio can be maintained constant within certain limits of the burner capacity.

(3) Burners designed to mix the gas and air mechanically, both under pressure, but without using the kinetic energy of either, (*a*) nozzle-mixing blast burners, (*b*) "premixers," (*c*) steam power burners, and (*d*) drilled cap burners used in a few ceramic plants.

V. Typical Gas Firing Systems Now in Use

(1) Gas Pipe Firing System Gas pipes with drilled caps are placed so as to extend into each fire box. This system is similar to that used in firing sewer pipe, fire brick, and enameled brick. The air for combustion is pulled into the fire box by the natural draft of the kiln. Some adaptations of this burner inspirate a small portion of the air through the burner; others cause a mixing of the gas and air as the mixture passes through a fireclay throat into the fire-box opening. This type of firing system is inefficient in that the amount of air admitted for combustion is difficult to control.

NOTE: The maximum of fuel economy is present only when just sufficient air for combustion is admitted into the fire box. If insufficient air is introduced into the kiln, a poor fuel economy is obtained due to the formation of some carbon monoxide as the gas is burned. This not only gives poor fuel economy but also causes clay bodies to become flashed and glazes to be blistered and pinholed.

In firing most glazed ware, an actual surplus of air over that required for perfect combustion conditions is needed. This excess air produces the condition of "oxidizing atmosphere." If, however, an excess of air is admitted over that actually required to produce oxidizing conditions, the fuel economy begins to fall off at an alarming rate. At the same time the color of the body lightens considerably and the glaze finishes become sugary and shiny. Pinholes in the surface are usually present when an over-oxidation of the body has taken place. The only means so far devised to regulate the amount of air going through the fire box in a draft system is the use of the stack damper. This is a most unsatisfactory method due to its lack of control.

This type of burner has been used both on muffle and open-fire kilns, but in neither case is the heat distribution any better than when using a fuel subjected to much less control than is natural gas. It also induces the use of a muffle because of the long length of flame. Gas when burned within the ware setting induces all of the defects which accompany a reducing atmospheric condition.

(2) High-Pressure Inspirating System The high-pressure burner is designed to inspirate only part of the necessary air for combustion. The remaining air is drawn through the fire box by the natural draft of the kiln. This type has few advantages over the plain pipe burner other than somewhat better control of the products

of combustion, and the gas is burned with a much shorter flame than with the pipe burner, due to some mixing of the gas and air in the burner.

It was thought that if a high-pressure burner could be devised to inspirate all of the air necessary for combustion along with the required excess, the muffle could be removed and the products of combustion thrown directly into the ware setting. A burner was devised so that the resulting air-gas mixture could be made noncombustible at the burner even though one of the flame-retaining type was attached to the end of the inspirator. This indicated that 4% of the gas-air mixture was being used to inspirate the other 96% of the total mixture inspirated. Yet this same burner can be used to produce reducing conditions within the kiln by a simple adjustment of the air shutters.

The disadvantage of this burner and all other high-pressure burners, even though subject to perfect control of its products of combustion, is that the mixture pressure is extremely low, usually amounting to several inches of water pressure. With such low-mixture pressures it is impossible to force the products of combustion from the fire boxes into the upper and center sections of the kiln by means of the mixture pressure. If not removed as fast as they are formed an intense heat is localized within the fire box. This causes the ware adjacent the fire box to become overfired and the portions farthest away to be underfired. The only alternative is to increase the kiln draft so that the products of combustion are carried out of the fire box and up into the ware. When the kiln pressure is reduced from a positive to a negative quantity, air is drawn into the fire-box openings, immediately changing the analysis of the combustion products. The burner then loses any advantages it may have had over the ordinary high-pressure gas inspirator in that the combustion products can no longer be closely controlled.

(3) Premixing Firing System This system consists of a motor connected directly to a small capacity blower, with provisions for admitting gas into the blower intake. The gas is then mixed mechanically with the air and the combustible mixture is delivered to the furnace through a flame-retaining burner.

This type of burner has little adaptability for periodic kiln firing due to its lack of flexibility. To adjust the gas being burned, each fire box must be supplied from a separate mixer set, the cost of which is very high. This is due to the fact that it is not possible to place dampers in the mixture-delivery line without the burners back-firing. Another disadvantage is that the mixture being delivered to the burner is of an explosive nature, whereas in most systems the gas and air are not mixed until reaching the burner and so are not explosive.

(4) Carboradiant Open-Fire Firing System Although little used for ceramic kilns with gas as a fuel, it has been used occasionally in the East with fuel oils. This system comprises a series of silicon-carbide double-pass flues of considerable length, but of small cross-section area. The fuel is fired into one end of the bottom pass where the combustion reactions are completed. The nature of the refractory used in the flue construction permits a maximum amount of heat to radiate through the wall of the flue into the ware. The products of combustion pass out of the openings in the upper passage into the kiln.

The initial as well as the maintenance costs are high and except for oil firing with extremely heavy fuels the system has little utility for periodic firing. The chief improvements claimed by the manufacturers of this equipment seem to be the decrease in fuel costs due to open firing the ware and to the improved quality when changing from open-fired coal burning to open-fired oil burning.

NOTE: An inspection of some of the data and descriptions of the kilns equipped with this firing system is of some interest.

Whitaker[1] has stated that no more fuel economy was experienced in an oil-fired kiln equipped with the carboradiant features than the same kiln when open-fired with coal. An improved quality is claimed, however, due to the absence of ash and soot from the oil-fired glazed products. That is to be expected in open firing, when changing from coal to oil regardless of the method of burning the oil fuel.

In a survey[2] of the Ford's Porcelain Works of Perth Amboy, New Jersey, it is stated that thirteen rectangular kilns, all equipped with the carboradiant features, have replaced thirteen round oil-fired muffle periodic kilns and have about the same ware capacity as those they have replaced. These kilns cost about $8000 each to install and have effected a decrease in the fuel-oil consumption from 3700 gallons per kiln to 2700 gallons, a decrease of 26%. They have also decreased the firing time from 120 to 100 hours, a decrease of 17%. These savings seem large unless studied with care.

Two manufacturers of glazed products are firing a like product to the same temperature under the same conditions. One uses gas-fired muffle kilns, the other uses open gas-fired kilns. The former has a fuel consumption of over 20,000 cubic feet of gas per ton of ware, while the latter uses less than 14,000 cubic feet of gas per ton. The differences in the fuel consumption can be charged mainly to the use of the muffle in the former case. There is a 30% saving in fuel by eliminating the muffle. The former fires off a kiln in 100 hours, the latter, in 47 hours, a decrease of 53% firing time. This indicates that the savings in the Ford's plants are usually due to the removal of the muffle rather than to the use of the carboradiant flues.

Users of periodic muffle kilns that have changed to open-fired carboradiant kilns have not claimed that they have improved the quality of a product that was previously fired in muffle kilns, regardless of the fuel formerly used.

There is no doubt but that the high heat radiation features of this system would be of considerable value if this increased heat radiation could be utilized. This so far has evidently not been possible as all published data indicate that a flash wall is placed between the combustion flues and the ware within the kilns. This is not only done with their rectangular kilns, but also in a round downdraft hollow building tile kiln in use in a machine-made glazed hollow tile plant. The original inside diameter of this kiln was 36 feet, but has been cut down to 29 feet due to the addition of flues and a continuous flash wall to the interior of the kiln. A decreased fuel consumption and an increased evenness of heat distribution is now claimed for the kiln. If the effective diameter of the above kiln were decreased seven feet more, it is likely that even better fuel consumption and heat distribution would result. Manufacturers of glazed ware have long ago decided that a kiln of such a large diameter can not be handled efficiently in firing any glazed product. Any ceramic manufacturer with $100,000 to invest in kiln equipment would do well to look into the merits of a tunnel kiln with which he can undoubtedly make a real saving in all of the various kiln-firing operations.

(5) Low-Pressure Air Inspirating System Low-pressure inspirator burners utilize the kinetic energy of an air stream to entrain gas in an adjustable proportion into the burner. Gas from a 4- to 8-ounce supply line is reduced to atmospheric pressure by means of a reducing valve or regulator. Air from a few ounces to 50 pounds pressure is used as the entraining medium, the requirements demanded of the burner and the available supply determining this pressure. The most economical air-pressure range is from 8 to 32 ounces.

[1] F. A. Whitaker, "New Method of Direct Firing Glazed Ceramic Bodies," *Jour. Amer. Ceram. Soc.*, **12** [2], 91 (1929).

[2] Published by A. C. Nielsen Co., Chicago, Ill., and abstracted by F. A. Whitaker in paper cited in footnote 1.

This mixture pressure varies directly with the air pressure used and for the usual range of pressures as described amounts approximately to 30% of the pressure applied on the air intake. This high-mixture pressure is of considerable utility in the firing of periodic kilns. This burner, when sealed into the furnace, will work against a kiln pressure almost as great as the mixture pressure and the combustion products are expelled with sufficient velocity that they do not build up a high temperature in the fire boxes but are forced up into the kiln spaces and there create a positive static pressure.

The proportion of gas to air is adjustable. If the demands of the burner are within its turn-down range the proportion of gas to air will remain constant after once being adjusted, regardless of the volume of mixture being burned. By adjusting the air-gas ratio of the burner it is possible to vary the products of combustion so that atmospheric conditions from extremely oxidizing to extremely reducing will be maintained in the fire boxes and setting space. The gas and air are intimately mixed before they are delivered to the burner and so the mixture burns with an extremely short flame. Even though the burner is operating at its maximum capacity under neutral or oxidizing conditions, the flame is still retained within the limits of the fire box. This permits the removal of all muffle crowns and flash walls except those necessary for the proper distribution of the applied heat.

FIG. 1.—Gas-fired kiln equipped with a low-pressure air inspirator.

A kiln equipped with this type of burner is subject to excellent temperature control. No difficulty has been experienced in maintaining the same temperature in the extreme bottom of the kiln as directly under the crown throughout the firing. Such being the case, it is possible to finish off a kiln so evenly that the extreme variation in heat treatment is not over one-half cone.

The flexibility of the temperature distribution is such as to permit either the top or the bottom of the kiln to be fired off at a temperature of 150°C higher than the other. To illustrate, the entire top of the kiln may be fired to cone 6 down while the whole bottom is being fired to cone 01 down, or cone 01 could be bent in the top and cone 6 could be bent in the bottom. With just as much ease, it is possible to fire products maturing at various temperatures within the same kiln by a mere regulation of the static pressures within the kiln. Of all the advantages gained by the use of the low-pressure firing equipment, probably the most important feature is that a positive static pressure is maintained throughout the fire boxes, kiln, and stacks.

VI. Pressure Firing as Applied to Periodic Kilns

Pressure firing is a feature that is common to but few periodic kilns. The areas of a kiln setting carried at the highest positive static pressures are usually at the highest temperature. To bring up the areas that are

constantly running behind in heat treatment it is customary to increase the pressure on those parts that are behind by lowering the stack damper. This is described as "soaking."

Kiln firing with low-pressure inspirators is a continuous repetition of this "soaking" effect throughout the firing. By a regulation of the amount of this soaking effect it is possible to carry the usually backward portions of the kiln along with those that are always ahead.

A kiln fired under a positive static pressure eliminates the need of all secondary air provisions. After the removal of mechanical water has been accomplished, the kiln pressure is raised to a value that prohibits the admittance of all secondary air through the burner holes, cone sights, or kiln cracks. From this point to the end of the firing any excess oxygen

FIG. 2.—Periodic kiln illustrating pressure firing equipment.

content in the kiln atmosphere is injected through the burner as excess air and is therefore under perfect control. In firing a kiln with this equipment it is possible to maintain the minimum of excess air in the kiln atmosphere compatible with the period of firing through which the ware is progressing. To illustrate, the excess air within the kiln is reduced from approximately 100% during the moisture removal period to an excess of 30 to 40% through the oxidizing period and a still further reduction of 10 to 15% throughout the maturing range of the ware.

The combustion products being subject to such accurate control, the fuel consumption is at all times held to a minimum, due to the sparing use of excess air. Being subject to such accurate regulation of the combustion products, the necessity for firing with a muffle is entirely eliminated. With elimination of the muffle and the increased firing efficiency, not over 50% of the B.t.u. consumed in a coal-fired muffle will be required in a corresponding open-fire gas firing.

The mixture leaves the burner with such velocity that even though the

burner is fixed four inches away from the fire-box opening, a sufficiently static pressure is built up within the fire box to produce the desired pressure effects within the kiln chamber. The intervening space between the burner and the fire-box opening permits a visual inspection of the flame color at any time. As is common to any velocity burner the gas is burned with an accompanying noise, the noise being the greatest when the mixture is so proportioned that conditions of perfect combustion are present. A kiln fireman experienced in the use of this type of equipment soon learns to correlate the sound of the burners with conditions of ideal firing. In other words, he correlates the sound and color of the flame with the percentage of carbon dioxide in the combustion products. When this has been accomplished the necessity of a constant and frequent analysis of the combustion products has been eliminated. It is impossible to expect the average kiln fireman to make gas analyses, nor can he be expected to understand one even if it has been taken for him.

The separation of the flame-retaining burner from the fire-box opening allows the burner to operate indefinitely without being fired off, due to the elevated fire-box temperature.

NOTE: Few data have ever been published as to the effect of combustion products on the firing behavior of glazed finishes when open-fired. We are told that in firing glazed products an oxidizing atmosphere is essential. But this oxidizing atmosphere varies from a 2% carbon dioxide content just before a coal firing to a content of over 10% just after firing, and such a varying content can hardly be correlated with any firing behavior of glazed finishes.

Some time ago, a manufacturer of glazed products had difficulty with a mat-finished base glaze which matured with a shiny texture. This variation was said to be due to an overfiring of this finish although cone plaques failed to substantiate this opinion. This same glaze when fired in an open-fire kiln to the same temperature with oil, fired with a rough and punky texture and at times showed a decided segregation of any added color.

It has since been demonstrated that this same mat base glaze when matured under the proper atmospheric conditions can be overfired sufficiently to cause its tin oxide content to go into solution and the over-matured glaze to start to run off the body and yet retain its desired mat texture and be free from pinholing and blistering after cooling. It has been demonstrated that this glaze can be varied in texture from an extreme mat through a pleasing satin finish to one extremely bright and sugary in appearance, merely by changing the composition of the combustion products within the kiln. It has also been demonstrated that a glaze can be tested in a small experimental furnace for a determination of the desired products of combustion and will mature with a similar finish when fired commercially if the combustion products are duplicated.

(1) Labor Savings The labor required to fire this type of equipment usually consists of a two-man gang, each man working a 12-hour shift. All kilns are started so as to finish during a day shift. This permits the man on night shift to ring any signal alarms and to tend any driers in addition to tending all kilns being fired. The man on the day shift is at liberty for three-quarters of each hour to do any general maintenance work around the plant, except when he is actually finishing off a kiln. The actual kiln-finishing requires about three hours of the forty-seven hours that are the average length of firing for a 30-ton kiln. The cooling of this same kiln requires three days' time. This plant can turn over each 30-ton kiln once every seven days, allowing two days to fire, three days to cool, one and one-half days to load, and one-half day to unload. This is quite a contrast from the 120-hour firing period, five-day cooling, and two-day loading and unloading time that was required under the coal-fired muffle firing conditions. This corresponds to an

increase in kiln capacity of over 35% with no increased investment in kilns. All firing equipment is standard in dimensions and is moved from kiln to kiln as each is finished off. This permits three and one-half kilns to be fired each week with an investment for sufficient equipment to equip only one kiln.

(2) Building Heating By far the greatest material saving effected has been the elimination of all boilers used for drying and steam building heating. Hundreds of analyses of the combustion products from these kilns have failed to show the presence of more than a trace of carbon monoxide. With this information at hand a duct system was arranged around the plant to receive the products of combustion from a firing kiln. The heat ordinarily wasted from firing and cooling a kiln has been found sufficient to furnish all the heat necessary to heat the buildings for four days, and is usually used whenever available. The combustion products are tempered with sufficient cool air so that even when the product is going through the oxidation period the sulfurous gases that are being distilled from the clay body are not offensive. A portion of this heated air is supplied to the pressing floor where it is used to expedite the removal of pressed ware from the molds. The discontinued use of the boilers has effected a saving of from twenty to thirty dollars per day during the colder months of the year, with just as good results as when heating was accomplished with steam-coil radiators.

FIG. 3.—Waste-heat collecting duct from a gas-fired periodic kiln.

Recirculating direct-fired gas driers have replaced the slatted floor steam-coil variety formerly used. These have decreased the drying time from sixty hours to twenty-three hours with a present drying fuel consumption of 2000 cubic feet of gas per ton of dried ware. The combustion products from one of these drying heaters are blown into the building heating duct and distributed around the plant when no kiln heat is available.

(3) Kiln Maintenance It is acknowledged that gaseous fuels are not as detrimental to the life of kiln refractories as are oil and coal. The combustion products from burned natural gas contain no ash which is the main factor in the slagging of clay refractories.

Although the fire boxes at times become extremely hot, the temperatures are well below even the incipient fusion range of a medium-quality fireclay refractory.

In changing over to a pressure firing system it is always advisable to put all of the fire boxes in first-class shape. The heat in the fire box melts the slag that has eaten out the mortar joints and allows the arches and side walls to fall. It is not uncommon to see a fire box in a gas-fired kiln that has gone through twenty-five firings still retain the original color of its fireclay shapes.

In dispensing with the muffle of a kiln, the cause of most of the main-

tenance cost of this type kiln is eliminated. If the flash walls are properly braced against the outside kiln wall, no trouble should be found in keeping this wall in shape. The wall is usually built up of all the straights and bats that have been removed from the original flue system and few new brick are needed.

VII. Summary

In summarizing the advantages gained by the use of a positive pressure firing system, the advantages are all so important in the production scheme of a ceramic plant that it is difficult to state which is the most important. Their relative value will vary for each individual producer of the different ceramic products. For instance, a terra cotta manufacturer is always interested in reducing the cost of his product, but an item which is even more important to him is the decrease in time required to manufacture his product. As has been shown, a saving of five days has been made by this newer method of drying and firing. The large decrease in the firing and cooling time is the most radical change effected in this type of kiln firing. It is hardly conceivable to a kiln fireman that a product can be fired in less than forty-eight hours with better temperature control than has been possible in firing the same product in 100 to 140 hours.

The factor that has prevented a short firing time is the lack of uniformity in heat distribution. With the use of the muffle system, plant operators have fired small monkey kilns off in much less time that they did their larger kilns. The difference in firing time is accounted for in the better heat distribution of the smaller kilns.

Under these newer conditions of absolute control, it is possible to eliminate all of the time that is usually wasted in bringing up portions of the ware to the same degree of maturity as is present in the remainder.

The physical and chemical changes that take place in a ceramic body during the firing operations are progressive and are completed within definite temperature ranges. When the heat distribution is uniform the entire kiln charge goes through each firing stage before any portion of the ware goes through the next succeeding stage.

In cooling almost any ceramic body, the only dangerous period through which the body must pass is that during which the free silica is undergoing a transformation from beta to alpha quartz at approximately 575°C. When the entire kiln of ware undergoes this change at the same time considerable time can be gained by fast cooling before and after this physical change has taken place. When succeeding portions of the ware, however, are undergoing this change the rate of cooling must be decreased in order to care for the parts that are ahead of and behind the remainder. A kiln of this type is subject to control as accurate in cooling as it is during the heating-up operation. The bottom temperature may be maintained within 20°C of the temperature of the extreme top throughout the entire cooling period.

In the average buff or white body, the impurities that undergo chemical decomposition during the oxidation period are a low percentage. It has not been proved that it requires the allotted 40% excess air to oxidize thoroughly this type of body. This figure was merely assumed and used, due to lack of available information, as a figure that represented a considerable factor of safety.

VIII. Conclusions

After using the kiln-firing system which has been described for a period of two years, all expectations have been realized and the system has been a complete success. The following conclusions are offered on the advantages obtained from pressure firing:

(1) Complete control of heat distribution, (2) complete control of composition of combustion products without necessity of an Orsat analyzer, (3) decreased time required for firing and cooling, (4) lower kiln maintenance, (5) lower firing labor costs, (6) decreased costs in building heating due to use of recovered heat, and (7) extreme sizes of kilns being of no disadvantage in firing with this system, since a 100-ton kiln is as easily controlled as a 10-ton kiln.

The only apparent disadvantage found up to this time is the initial cost of equipment, and although the cost of the equipment for the first kiln is high, it must be remembered that the only part of the equipment that can not be made portable is the air and gas line around and leading to each kiln. One blower and a set of burners will handle three and one-half kilns per week (48-hour firing period). The blower that has been used has sufficient capacity to fire two kilns at a time or, in other words, a kiln finishing off each day. When the equipment cost is prorated over such a kiln capacity it is evident that the initial cost is nominal.

WINKLE TERRA COTTA COMPANY
ST. LOUIS, MISSOURI

A MUFFLE KILN OF HIGH EFFICIENCY*

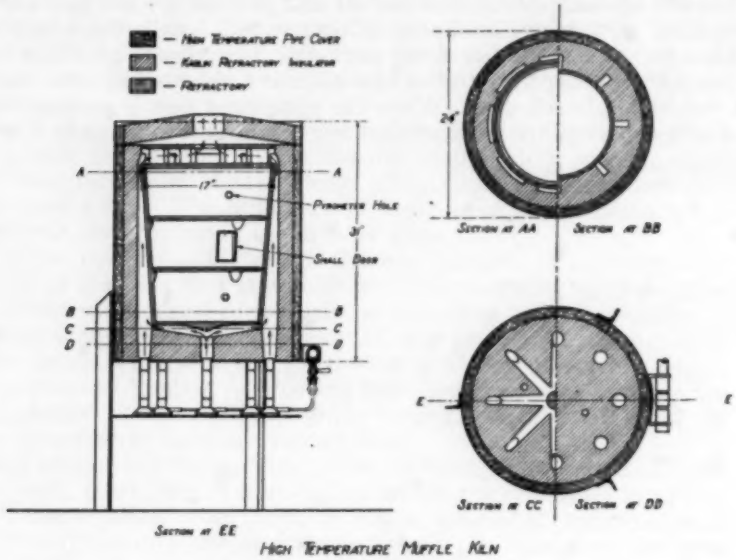
By F. H. Norton[1] and J. V. Duplin, Jr.[2]

ABSTRACT

A new type of muffle kiln particularly suited for instruction, research, or the studio is described. A high efficiency, high maximum temperature, and quick action are its distinguishing features.

The desire to improve the available firing equipment for ceramic products in our laboratories has led to the development of a number of new kilns and furnaces. One of these should be of interest to those engaged in ceramics because of its high temperature range, its even temperature distribution, and its high efficiency.

A drawing of this kiln is shown in Fig. 1. The construction should be clear without a detailed description, but a few features warrant comment. The kiln chamber is a closed muffle completely surrounded by



High Temperature Muffle Kiln

Fig. 1.

hot gases; to prevent the top from being colder than the bottom, as is always the case in an updraft kiln, the gas passages are gradually changed in shape so that as the gases cool, a larger and larger area is presented to the muffle wall. The large working space inside of the muffle should also be noted in comparison with the outside dimensions. The efficiency of the kiln is primarily due to the use of a kaolin refractory insulator to carry the hot gases. This material is not only a good insulator, but has such a low density that little heat is absorbed.

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[2] Babcock & Wilcox Fellow, Mass. Institute of Technology.

The setting of the kiln is done from the top after removing the covers. This method of setting has been found safer and more convenient than setting through a door. However, a small door is provided for watching the interior of the kiln or for extracting trial pieces.

The kiln is fired by nine Méker type burners as commonly used in the laboratory. Five burners, however, are sufficient for anything except high-fire porcelains.

The performance of the kiln under various conditions is shown in Fig. 2. The highest temperatures of 2550°F for nine burners and 2200°F with five burners are not by any means the maxima under these conditions. This kiln has never shown a difference of more than 10°F from one part of the muffle to another, which allows the successful firing of bodies and glazes with a very narrow firing range.

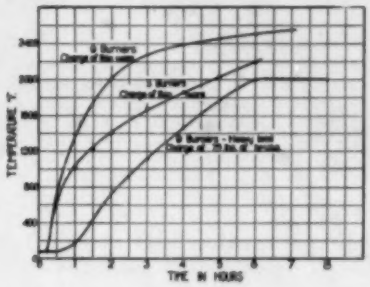

FIG. 2.

The gas consumption, using manufactured gas of 520 B.t.u., is shown in Fig. 3. The efficiency with a charge of 75 pounds of brick is 10%, which would be considered good for a large muffle kiln operating at this temperature. The efficiency is, of course, lower for smaller charges.

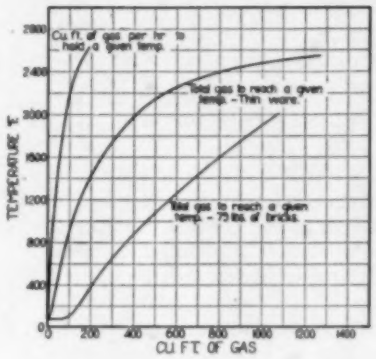

FIG. 3.

The reasons for adopting this type of kiln may be summarized as follows:

(1) The quick temperature rise allows a firing to be made in a laboratory period.

(2) The evenness of temperature permits precise firing of the whole charge. There are no hot or cold spots.

(3) The high temperatures available allow the firing of high-fire porcelains and refractories.

(4) No direct chimney connection is required, so the draft is unaffected by the weather.

(5) The method of setting is greatly improved over the usual setting through a door.

(6) The efficiency is so high that the cost of gas for an art-ware firing at cone 03 is from 15 to 50 cents, depending on the price of gas.

REFINING OF PACIFIC NORTHWEST KAOLINS BY AIR FLOTATION*

By Hewitt Wilson[1] and Jack A. Cunliffe[2]

ABSTRACT

Preliminary tests were made of various types of grinding and pneumatic systems to separate the kaolin, mica, and quartz components of kaolin rock in comparison with water-washing tests. It was found best to remove the coarse quartz and mica as completely as possible in the grinding compartment and to use pneumatics for the separation of the finest particles. Pulverization of kaolin rock increased the quartz and mica content of the purified kaolin even with the best methods of pneumatic separation.

I. Introduction

Experimental tests and commercial practice have shown that most of the costs of kaolin purification are in the removal of the water used for washing. The initial dewatering by settling in large tanks readily reduces the dry contents of the slip to 25% solids, but filter pressing and evaporation are required for complete dewatering. Filter pressing is particularly difficult with highly plastic kaolins such as those found in the Pacific northwest. With the use of air flotation, the cost of dewatering is eliminated, although if the material is damp, it may be necessary to dry it before pulverizing.

II. Refining by Pneumatic Process

Air separators have been used for years. Several companies in Georgia and South Carolina employ pneumatic methods to remove mica, quartz, and iron-oxide impurities from kaolin.

Various methods have been suggested, patented, and used for the air separation of minerals, chiefly clay. Georgia and South Carolina companies are using Alton's[3] methods followed in some cases by water purification of the grit residues which contain too much clay for discarding.

The clays of Georgia and South Carolina which have been purified by air treatment contain very small amounts of sand and mica. As far as is known, no kaolins which are highly sandy or micaceous are cleaned by air methods. The object of this investigation was to determine whether the kaolins of eastern Washington and northern Idaho which contain from 20 to 80% quartz and muscovite sand can be cleaned by air flotation.

III. Experimental

(1) Manufacturers' Tests

In 1931, samples of representative Washington and Idaho kaolins were tested by three manufacturers of air separators. The results obtained by air separation will be given only for kaolin No. 1, a tough, plastic clay containing 42.7% sand and mica.

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[2] Research Fellow, University of Washington, 1931–1932.

[3] W. H. Alton, Treatment of Clay, U. S. Pat. 1,771,477, 1,771,478, 1,771,479 (1930).

(2) Results of Company A After grinding in a pulverizer equipped with an air separator, followed by one treatment in a selective air separator, 75% of the feed was recovered as finished product, 96% of which passed 300-mesh. Company A recommended an initial grinding treatment which would not pulverize the sand and mica so completely.

(3) Results of Company B Company B ground the kaolin in a hammer mill equipped with $^1/_8$-inch spaced grates, giving a product about 30% through 300-mesh. The Georgian kaolins are 50 to 60% finer than 300-mesh after a single passage through the hammer mill. The selective air separator gave a product 98.5% finer than 300-mesh. The tailings were reground in an emery mill and a second passage through the air separator resulted in a total recovery of 65% of the original feed. Company B believed that a portion of the sand and mica had been ground fine enough to be included with the finished product.

(4) Results of Company C Company C recovered a 20% fine product after grinding and selective air separation.

IV. Laboratory Check Washing Tests

The 100-gram samples of each air-purified sample returned by Companies A, B, and C, were thoroughly dispersed in two liters of water containing a few drops of sodium silicate and allowed to settle for three minutes. The water and suspended material were then carefully decanted. This was repeated until no material remained in suspension after standing one minute.

TABLE I

CHECK WASHING TESTS OF AIR-FLOATED MATERIAL (300-MESH) FROM MANUFACTURERS' TESTS OF KAOLIN NO. 1

Sample	Sand and mica (%)	Kaolin (%)
Original product	42.7	57.3
Company A	20.7	79.3
Company B	22.0	78.0
Company C	17.7	82.3

The washing tests indicated unsatisfactory products from the air separator. While the quartz and mica had been pulverized finer than 300-mesh, the kaolin content was too low for the best uses. Sand which just passes a 300-mesh sieve is regarded as grit in many industries and does not find a sale in competition with grit-free water-washed products. Fired tests showed an increase in black specks. These data indicate that the samples had been given a too severe grinding treatment.

V. Roll-Crushing Tests

To determine the disintegrating action of roll crushing, original kaolin rock was passed through a jaw crusher with jaws spaced between spring rolls at $^1/_2$ inch, $^1/_4$ inch, $^1/_8$ inch, and zero. These adjustments were made without load. The material from each test was sieved dry through six Tyler standard screens, 10-, 20-, 35-, 48-, 65-, and 100-mesh. Each sieved size was then washed to determine its sand content and the results were checked against the sieve analysis of the head sample.

The best results were obtained with zero spacing.

The data obtained clearly show that roll crushing is ineffective in freeing the kaolin from the sand grains. The quick squeeze-crush of the roll grinder is not as effective as an impact or rubbing action.

VI. Ball-Mill Grinding Tests

The original kaolin rock was given a $^1/_4$-inch roll crushing and then ground in a porcelain-lined pebble mill 12 inches in internal length by 10 inches internal diameter, rotating at 50 revolutions per minute for 15-minute intervals. The charge consisted of 4 kilograms of $1^1/_2$-inch pebbles, 6 kilograms of $^3/_4$-inch pebbles, and 4 kilograms of crushed kaolin.

The total time of grinding for the first test was 15 minutes. In the second test the material coarser than 100-mesh was returned to the mill for an additional 15-minute grind; and in the third test, the screening and grinding were repeated for a third 15 minutes.

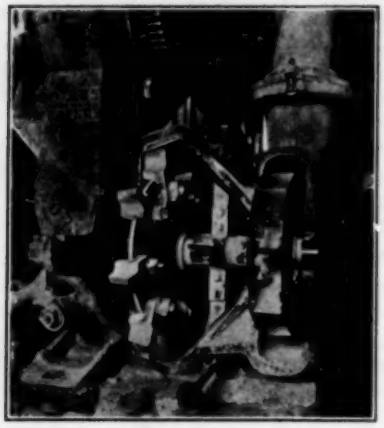

FIG. 1.—Close-up view of pulverizer showing feeder on upper left, impact blades in center, and fan on right. Two sand holes can be seen in housing under the impact blades.

The data indicate that during the first part of the grinding the kaolin was pulverized faster than the sand. At the end of fifteen minutes the kaolin content of the product finer than 100-mesh averaged 16.7% above the kaolin content of the original sample. This advantage disappeared with prolonged grinding. At the end of the second fifteen-minute test the −100-mesh portion averaged only 3.2% more than the original, and at the end of the third fifteen-minute interval it contained 18.3% less kaolin than the original. This lowering of the kaolin content in the fine material indicated that the sand had been pulverized during the fifteen- to thirty- and the thirty- to forty-five-minute periods.

A 100-pound sample, sent to an eastern manufacturer of pulverizing equipment, was given a treatment in an air-ventilated ball mill. It was found that 31.0% of the fine product was sand and mica. This indicates that the ball-mill grinding was too severe and a proper balance was not obtained between the grinding action and the air currents. Some arrangement likewise must be made for a continuous discharge of the sand and mica residue. If this is accomplished, the ball mills now used for powdering coal, feldspar, and flint in closed circuit with an air separator should be tried on kaolin.

VII. Impact-Pulverizer and Air-Flotation Tests

Tests were made with a laboratory-size, impact pulverizer with a non-selective air separator, shown in Fig. 1. The machine was reduced from the manufacturer's specification of 3600 r.p.m. to about 2100 r.p.m. to lessen the pulverizing of the quartz and mica.

Preliminary tests were unsuccessful at the slower speeds because the reduced air current could not carry the unground sand from the pulverizing chamber, and the machine clogged. Four holes were then drilled through that side of the pulverizing compartment toward which the sand was thrown by the rotation of the beater arms. Three of these holes were placed directly in the plane of rotation of the beater arms, and one was placed to one side nearer the feed hopper. By this method the sand was pulverized only partially in the grinding chamber and fell to the bottom of the housing where it ran through the drain hole, while the clay was lifted by the fan to the air-separating compartment.

The speed of rotation of the impact pulverizer was varied from 1846 to 2340 revolutions per minute by changing the size of the driving pulley, and the number of beater arms on the pulverizer disk was varied from two to eight to give a range in the degree of pulverization. The products consisted of two portions, (1) the sand tailings, with a small percentage of clay, rejected from the drain hole, and (2) the purified clay, containing some sand and mica, separated from the air in the cyclone collector.

Kaolin No. 2 is a tough, plastic clay from the same deposit as kaolin No. 1, but with a different sand content. Twenty-eight air-separation tests were made.

Table II shows the relationship between the number of beater arms, the speed of pulverizing disk and fan, and the per cent of sand in the recovered clay.

TABLE II

RELATION BETWEEN SAND CONTENT OF RECOVERED CLAY FROM KAOLIN NO. 2, NUMBER OF BEATER ARMS, AND RATE OF ROTATION

Rate of rotation (r.p.m.)	1800	2100	2340
No. of beater arms	Sand in the recovered clay (%)		
2	24.4	6.3	14.1
4	12.4	9.9	14.9
6	12.5	6.1	8.6
8	14.6	9.9	22.0
Average	16.0	8.0	14.9

The lowest sand content in the recovered kaolin was obtained at 2100 r.p.m. The most efficient number of beater arms was doubtful and the position of the sand-drain holes was unimportant.

The comparatively coarse residue from the 1846 r.p.m. test was largely bulky flakes of white muscovite. At the higher speeds these disappeared and apparently were pulverized just finer than 325-mesh or floated with the kaolin in the check washing test.

Kaolin No. 3, a residual, weakly plastic, coarse-grained clay, which contained 72.8% sand and mica with 27.2% kaolin as determined by water washing, was also tested in the impact pulverizer and air separator.

In testing both kaolins (No. 2 and No. 3) the amount of total clay recovery, as indicated by the check washing tests of the clay float and sand reject from air separation, was 7 to 8% greater than the clay recovery from the water washing of the original sample. Apparently this amount of impurity, largely mica, had been ground in the impact pulverizer so fine that it floated with the clay in the one-minute suspension test. The higher speeds, 2340 and 2100 r.p.m., showed 2.8 and 5.3% greater amount

of this fine water-floating mica than did the lower speed, 1846 r.p.m. Averages taken from data not included in this report show that the amount of clay found in the sand reject varied inversely with the speed of the

TABLE III

PARTIAL CHEMICAL ANALYSES AND P.C.E. VALUES OF RAW, AIR-FLOATED KAOLINS AND SAND REJECTS

Material	Silica (%)	Alumina (%)	Fe_2O_3 (%)	P.C.E. value
Kaolin No. 2 (original)	63.6	25.7	0.6	30+
Kaolin No. 2 (air-floated)	51.2	35.3	0.9	33
Sand reject (kaolin No. 2)	89.3	8.1	0.3	
Kaolin No. 3 (original)	71.9	19.4	1.1	31+
Kaolin No. 3 (air-floated)	50.6	35.0	1.8	32
Sand reject (kaolin No. 3)	88.6	8.7	0.7	

beater arms. Nine and six-tenths per cent was found at 1846 r.p.m., 8.1% at 2100 r.p.m., and 6.3% at 2340 r.p.m.

VIII. Tests of Air-Flotation Products

Chemical analyses and cone-fusion-temperature tests were made of the original, the air-floated kaolin, and the sand-reject product of kaolin No. 2 and kaolin No. 3.

The samples for these tests were mixtures of a number of runs and

TABLE IV

MINERAL CALCULATION OF AIR-SEPARATED PORTIONS, KAOLIN NO. 3[a]

Material	Air-separated portions (%)	Theoretical kaolin[b] (%)	Theoretical muscovite[c] (%)	Theoretical quartz[d] (%)		
Kaolin air-float	37	32.8	1.2	3.0		
Sand reject	63	2.2	11.0	49.8		
Total	100	35.0	12.2	52.8		
					Calculation total (%)	Analytical total[f] (%)
SiO_2 (%)[e]		16.2	5.5	52.8	74.5	71.9
Al_2O_3 (%)[e]		13.9	4.7		18.6	19.4

[a] Assuming that all the floating material in the check washing test is kaolin.
[b] 39.8 Al_2O_3, 46.3 SiO_2, 13.9 H_2O.
[c] 11.8 K_2O, 38.5 Al_2O_3, 45.3 SiO_2, 4.4 H_2O.
[d] 100.0 SiO_2.
[e] Per cent of total sample in mineral fractions.
[f] See Table II, p. 157.

contained 10% sand and mica in kaolin No. 2 and 11.4% in kaolin No. 3. The results are given in Table III.

Table III indicates that a substantial reduction of the silica and an increase in alumina have been made in both kaolins by the use of pneumatic separation. The silica and alumina content of the sand reject from kaolin No. 2 indicates a content of mineral quartz 72%, muscovite 15.7%, and kaolin 11.3%. Similar calculations for the air-floated portions indicate a content of kaolin 90%, muscovite 0.8%, and quartz 9.2%. For kaolin No. 3, the sand reject contains quartz 79%, muscovite 17.5%,

and kaolin 3.5%, while the float has kaolin 88.6%, muscovite 3.5%, and quartz 8.1%. Table IV shows a summary of these results for kaolin No. 3.

(1) Testing Air-Flotation Products for Ceramic Purposes The air-floated and water-washed samples of kaolin No. 2 were given plastic, dry, and fired tests according to the standard methods of the American Ceramic Society. The results are given in Table V.

TABLE V

COMPARISON OF PROPERTIES OF WATER-WASHED AND AIR-FLOATED KAOLIN NO. 2

Plastic and dry data	Water-washed	Air-floated
Water of plasticity (%)	36.2	31.6
Shrinkage water (%)	15.3	12.6
Pore water (%)	20.9	18.9
Dry volume shrinkage (%)	25.3	22.1
Bulk specific gravity	1.645	1.743
Fired data (cone 12)		
Volume shrinkage (%)	36.0	31.2
Bulk specific gravity	2.29	2.27
Absorption (%)	4.51	4.45
Apparent porosity (%)	10.31	10.19
Transverse strength (lb./in.^{2})	1543	2115
Color	Near white	Near white

Table V shows that there is very little difference between the air-floated and the water-washed kaolin No. 2. The higher water of plasticity for the water-washed kaolin sample was caused by the lower sand content, as well as by the difference in tempering. The greater tempering water and the lower sand content caused greater shrinkage in drying.

TABLE VI

WHITEWARE BODY COMPOSITIONS

Material	Body A	Body B	Body C	Body D
Feldspar (%)	20	20	20	20
Air-floated kaolin No. 2 (%)	40	40		
Florida kaolin (%)			40	40
California flint (%)	40		40	
Sand reject, kaolin No. 2, ground to pass 200-mesh (%)		40		40
Total	100	100	100	100

The fired properties were similar except that the air-floated clay gave a higher fired strength.

(2) Whiteware Tests Plastic, dry, and fired tests were made to compare the properties of the air-floated kaolin No. 2 with the water-purified kaolin No. 2 and the pulverized sand reject from kaolin No. 2 with California flint. The body compositions are given in Table VI.

The results of the tests on the whiteware bodies are given in Table VII. The color of the standard body C was slightly whiter than the others, showing that the air-floated products contained some impurities. The tables show that the bodies containing the Washington air-floated clays

developed a greater degree of vitrification at lower temperatures than the others, which is believed from other experiments to be due to the basic composition of the kaolin which did not fundamentally change with purification treatment. The sand reject apparently contained enough clay, muscovite, or undecomposed feldspar to produce a greater degree of vitrification than the California "flint," as indicated by lower absorption

TABLE VII

COMPARISON OF WHITEWARE BODIES

Plastic and dry data	Body A	Body B	Body C	Body D
Water of plasticity (%)	23.8	24.2	24.5	23.8
Shrinkage water (%)	8.4	9.2	6.2	6.1
Pore water (%)	15.4	15.0	18.3	17.7
Dry volume shrinkage (%)	15.9	17.1	10.7	10.8
Fired date (cone 9)				
Bulk specific gravity	2.13	2.20	2.15	2.19
Volume shrinkage (%)	16.3	19.9	21.6	24.3
Absorption (%)	7.3	5.5	9.1	6.0
Apparent porosity (%)	15.5	12.2	19.1	14.1
Transverse strength (lb./in.^{2})	2843	3783	1770	2864

and greater strength of bodies B and D compared with those of bodies A and C.

(3) Testing of Sand Reject for Foundry Use

A composite sample of the sand reject from all the tests on kaolin No. 2 made with the air-flotation equipment was tested for foundry use according to the specifications of the American Foundrymen's Association.[4] The results of the tests are given in Table VIII.

TABLE VIII

FOUNDRY-SAND TESTS OF SAND REJECT FROM AIR-FLOTATION TESTS

Class of sand	3E
Fineness modulus number	114
Clay content (%)	10.0
Permeability (6% temper water)	33.8
Green compressive strength (6% temper water)	7.7
Permeability (8% temper water)	27.0
Green compressive strength (8% temper water)	6.8
Shape of grain	Angular

These tests, while incomplete, indicate that the sand possibly can be adapted for use as a foundry-casting sand for light castings. Large-scale tests must be made to determine the true suitability of the sand. The laboratory tests, however, indicate that it is worth continued investigation.

IX. Summary

Without doubt, air flotation will be used more widely in the purification of certain kaolins, refractory clays, and other special clays and non-metallic minerals which can be freed from their impurities by some simple

[4] Testing and Grading of Foundry Sands, American Foundrymen's Association, Chicago, 1931, p. 151.

treatment in the dry condition, and whose particles vary in hardness, size, or specific gravity from those of the impurity.

The clays which are best suited for air flotation are those having in the original condition the smallest amount of impurity with the largest particle size. Kaolins are softer and disintegrate to floating powder more easily than quartz grains, but dry kaolins differ from each other with respect to hardness, strength, and toughness. A softer, easily pulverized clay requires less impact or other grinding force to separate it from the impurity, and therefore less grinding and abrasion will be given the accompanying quartz, mica, or iron-oxide particles. Many kaolins of the Pacific northwest have the disadvantage of being tough and hard, and all known at the present time have a high content of sand with considerable fine mica.

The plate-like structure of mica particles gives them greater floating power per unit of surface area than minerals of the usual grain shape and hence mica particles of a large diameter in two dimensions will be found with kaolin and quartz particles of much smaller diameter. Because of their foliated structure, impact easily breaks the mica grains into plates of minute thinness, and the resulting flakes will be distributed in the kaolin. On the other hand, the blunging action of water washing is often not severe enough to separate the tiny mica booklets which therefore settle readily with the sand. The mica flakes are objectionable in paper fillers or other products where a shiny spot is not wanted, but a certain amount of fine muscovite mica can be used in clay for fired ceramics. The percentages of alumina and silica in mica are similar to those of pure kaolin itself and the potash of the muscovite is the same flux as that obtained by artificial additions of feldspar in the compounding of porcelain and whiteware bodies. Biotite, of course, must be completely eliminated.

The results of the above tests indicate that perhaps a modification of the air equipment used in Georgia for kaolin refining should, or could, be used for the sandy, micaceous kaolins. The tests made by the manufacturers clearly indicate that fine grinding produces a product from which the kaolin and quartz can not be separated as cleanly with the mechanical *selective* separators as by water washing, due to the similar specific gravities of the two materials.

Impact pulverization in the Bureau of Mines laboratory gave better results. The impact pulverizer was operated at slow speeds to reduce the quartz grinding, and the air currents were slow enough to avoid lifting more than 6 to 10% of sand and mica. For the best quality of kaolin, however, equal to that produced by water washing, it will be necessary to reduce the grinding action of the pulverizer still further without reducing air currents. This was impossible with the equipment at hand, and it is doubtful if any system can be found which will pulverize less than 10.0% of the quartz and mica to a size small enough to float with the clay.

The best method found in this study consists of separating the impurities from the kaolin in the grinding chamber without permitting the former to get into the air-floating system. The simple, rising column of air from the grinding chamber is thought to be a good, selective air separator for these sandy clays. Even though it is necessary to re-treat the tailings several times through slow-operating impact pulverizers, hammer

mills, or cage mills to remove the kaolin, this is more logical than a complete reduction of the impurities to fines for a selective, air-separator treatment. The selective air separator may prove its value in later experiments with the proper grinding preparation.

If, after further studies, it is found best to separate the kaolin and impurities in the pulverizing chamber as was done previously, several commercial machines are equipped with throw-out attachments in the housing of the pulverizing chamber for this purpose. If these are not suitable, other openings can be provided. Experiments should be continued with air-ventilated ball mills with or without small charges of pebbles. The laboratory experiments given above indicate that the kaolin is reduced to powder faster than the quartz and mica. Rubber balls, suggested in U. S. patent 1,771,477, rot too easily when used for dry grinding. Roll crushing was entirely unsatisfactory as a method of separating tough, hard kaolin from quartz and mica. With other kaolins of the soft residual type, which usually contain a large quantity of very coarse sand, it is possible to remove a portion of the coarse sand by screening after a preliminary crushing.

Two general methods should be considered for treatment of the sandy kaolins, (1) that used for the Georgia kaolins, which consists essentially of drying, impact pulverization, and treatment of the entire product through selective separators in one or more steps; or (2) that method suggested by this study, which consists of drying, impact crushing, and air separation of coarse quartz and mica from the kaolin in the grinding chamber itself. The recovered material, containing 6 to 10% of fine sand and mica, can then be treated by one or more selective air separators to produce a *small* amount of better-grade product. It may be necessary to regrind the air-purified kaolin with high-speed pulverizers to break down the larger particles of mica which have persisted in floating.

The data of this study indicate that the air-floated kaolin product of the sandy, micaceous clays will not be as pure as the product from the more expensive water-washing classification which does not pulverize the impurities. The air-purified products containing a small amount of impurities finer than 325-mesh, however, will have considerable sale for products in which small amounts of fine quartz and mica are not objectionable.

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CERAMIC ABSTRACTS[1]

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Abrasives

Size control technique in precision grinding. R. E. W. Harrison. *Abrasive Ind.*, **13** [12], 14–17 (1932).—H. gives some of the factors to be considered in grinding machine design. *Ibid.*, **14** [1], 15–17 (1933).—H. discusses the effect of the oil film, sizing mechanisms, ease of control, etc., upon precision grinding operations. He also calls attention to further improvements which will increase the automatic features of precision grinding machines. See also *Ceram. Abs.*, **12** [1], 2 (1933). E.P.R.

Grinding tools in many shapes. Norton Co. *Foundry*, **60** [10], 64 (1932).—A specially developed line of machine shop tools is described and illustrated, such as wheels, points, pencils, buttons, and more than 100 other shapes. These range from tiny points $^{3}/_{32}$ in. in diameter to wheels 1 in. in diameter. The spindle on these mounted abrasive products is made of a special steel which is first coppered and then nickel plated. It is knurled and designed with a chisel end to insure permanent anchoring of the abrasive on the quill, a special cement of high strength being used. F.G.H.

Grinder with cone-shaped wheels. Independent Pneumatic Tool Co. *Foundry*, **60** [6], 99 (1932).—A high-speed rotary air grinder designed to operate cone-shaped grinding wheels is described and illustrated. F.G.H.

Accuracy in antifriction bearings produced by grinding. Anon. *Abrasive Ind.*, **14** [1], 9–11 (1933). E.P.R.

Four simultaneous grinding operations on rear axles. Ford Motor Co. *Abrasive Ind.*, **14** [1], 12–14 (1933).—The rear axle shaft of the modern automobile is held within close tolerances on a number of dimensions, and the combination of rapid production with precision grinding of those members is described. E.P.R.

Precision grinding of heavy spindles. Westinghouse Electric & Mfg. Co. *Abrasive Ind.*, **13** [12], 17 (1932). E.P.R.

Refinements in finishing cylindrical bores. J. W. Hindes and J. G. Young. *Trans. A.S.M.E.*, **53** [MSP-13], 127–30 (1931); abstracted in *Mech. Eng.*, **54** [2], 150 (1932).—The limitations of boring, reaming, burnishing, and broaching as finishing operations on cylindrical bores have led to the general use of abrasives for such work. Improvements in manufactured abrasives, study of operating data, and improved methods of application have made grinding a precision process. The cost of operation and the difficulty of bearing maintenance of planetary-type grinders have brought about the use of the expanding grinder or so-called "honing" method. The latter method has the advantage of speed, improved accuracy and finish, and low cost. It also makes possible the precision grinding of long tubes, gun-barrel rifling, and bores with ports, keyways, and relieved portions. F.G.H.

Dependence of high-quality finish on special wheels and set-up. A. D. Meals. *Abrasive Ind.*, **13** [12], 12–13 (1932). E.P.R.

Exhaust unit for grinders and buffers. Standard Electric Tool Co. *Foundry*, **60** [11], 69 (1932).—A motor-driven exhaust unit which may be mounted on heavy-duty grinders and buffers is described and illustrated. F.G.H.

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[1] The abbreviation (*C.A.*) at the end of an abstract indicates that it was obtained from *Chemical Abstracts* by coöperative agreement.

The bold-face number following the journal name is the volume, the issue number is in brackets followed by the page numbers, then the year in parentheses.

Double-spindle polishing lathe. HAMMOND MACHINERY BUILDERS, INC. *Foundry*, **60** [5], 70 (1932).—Illustrated. F.G.H.

Diamond dust drills holes in dies. WESTINGHOUSE LAMP CO. *Abrasive Ind.*, **14** [1], 22 (1933).—Rough cut diamonds set in brass casings form dies through which tungsten wire is drawn for the filaments of Mazda lamps. Tiny holes in the diamonds are made by placing the dies in revolving spindle blocks on automatic polishing machines. E.P.R.

Tungsten carbide matrix holds diamonds in truing tool. W. C. WESLOW. *Abrasive Ind.*, **13** [12], 21 (1932).—The diamonds are distributed uniformly throughout the matrix so that an ample number is present at each new surface reached during the life of the tool. E.P.R.

Abrasives as aid to cloth production. FREDERICK B. HUDSON. *Textile World*, Oct., 1932; *Abrasive Ind.*, **14** [1], 11 (1933).—The importance of proper card grinding is pointed out. E.P.R.

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Abrasive materials in 1931. PAUL HATMAKER AND A. E. DAVIS. Bur. Mines *Mineral Resources U. S.* 20 pp. Price 5¢ from Supt. of Documents, Govt. Printing Office, Washington, D. C. R.A.H.

Factors affecting grinding wheel selection. NORTON CO. *Foundry*, **60** [8], 72 (1932).—Information in this booklet includes composition and characteristics of grinding wheels, fundamental factors for determining grinding wheel specifications, and the selection of a grinding wheel. F.G.H.

Buffing and coloring zinc before plating. NEW JERSEY ZINC CO. *Abrasive Ind.*, **14** [1], 14 (1933).—The revised edition of the research bulletin, "The Plating of Rolled Zinc and Zinc Die Castings," is discussed. E.P.R.

Requirements for cutting oils. STANDARD OIL CO. OF INDIANA. Monograph on Lubrication, No. 5; *Abrasive Ind.*, **14** [1], 14 (1933). E.P.R.

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Method of making articles of resin-bonded granular material. D. E. WEBSTER AND BAALIS SANFORD (Norton Co.). U. S. 1,893,117, Jan. 3, 1933. The method comprises the steps of making a mixture of abrasive grains and a resinoid powder with a neutral, nonaqueous liquid which is miscible with the plasticizer and will wet the grains and cause the resinoid to adhere thereto but without chemically reacting with the resinoid, thereby forming a stable mixture of abrasive and resinoid, and thereafter adding to the mixture a plasticizer for the resinoid and molding and heating the mixture to convert the resinoid and form an integral structure.

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Grinding method and means. T. B. SMITH (John Hassall, Inc.). U. S. 1,894,067, Jan. 10, 1933.

Tool and apparatus for leveling cylindrical surfaces from grinding disks. A. LEBERT. U. S. 1,894,181, Jan. 10, 1933.

Art and Archeology

Liquid gold. L. CHALMERS. *Brit. Ind. Finishing*, **2** [22], 201–203 (1931).—Liquid gold is painted on the glazed ware by hand. The ware is allowed to dry in a warm atmosphere and then slowly heated in a large kiln. As the temperature rises, the light brown layer of gold paint slowly darkens, retaining a wet appearance till about 250° is reached when it assumes a shiny jet black color. At 350° the black is slowly changed into a radiant "molten" gold surface and the temperature is raised to 750° to fix the gold layer on the glaze. A good quality liquid gold must conform to the following requirements: (1) It must dry quickly on application to the ware. (2) It must not have so low a viscosity as to cause running, and yet have good covering power. (3) It should be stable on standing over a long period. (4) After firing, an unblemished even surface should remain. (5) The surface brilliancy should still be retained even at high temperatures. (6) After cooling, the gold layer should adhere firmly to the glaze, revealing the true gold tone. The main constituent of liquid gold is gold sulfo-resinate. To obtain a strong adherence of the gilding to the porcelain, it is necessary to add a flux medium which may consist of various metals such as lead, antimony, tin, uranium, chromium, and bismuth. On firing, these flux metals bite into the glaze and form a binding medium between the gold film and the porcelain. A small quantity of rhodium is added to the gold emulsion to increase the resistance of the gilding at higher temperatures. An important factor in connection with liquid gold is the viscosity. Gold sulfo-resinate has not yet been prepared in a perfectly pure form and excess sulfur is liable to cause a darkening of the gilt. M.V.K.

Liquid silver: its use and manufacture. L. CHALMERS. *Brit. Ind. Finishing*, **2** [21], 181–82 (1931).—Liquid silver is an expensive overglaze preparation used for decorative purposes in the ceramic industry. It does not contain any silver, but is made of platinum and gold and is a dark brown, oily, sweet-smelling emulsion which is painted on chinaware and fired as an overglaze coating. Liquid silver is absolutely untarnishable and retains its brilliant finish. The "silvered" surfaces can be soldered together. Liquid silver consists of an essential oil solution of platinum sulfo-resinate intimately mixed with certain other metallic constituents. When the platinum sulfo-resinate solution is painted on porcelain and fired at about 300°, the light brown film slowly darkens. Bismuth and chromium are added to prevent this and to stabilize the surface at high temperatures; a small quantity of rhodium is added. By varying the ratio of liquid platinum to liquid gold, various other shades and qualities may be produced. M.V.K.

Verde antique finishes. ALBERT E. ROBINSON. *Brit. Ind. Finishing*, **2** [18], 120 (1931).—Verde antique is a very popular finish for art ware such as pottery, statuary, lamp fittings, etc. Natural verde antique is produced by atmospheric conditions forming a verdigris deposit on copper, and is more pronounced in sea air owing to the salt in the atmosphere and in industrial areas laden with chemical fumes. Directions are given for obtaining different verde antique effects by dipping or spraying. M.V.K.

Art of shaping vases. VII to IX. COSIMO ETTORRE. *Ind. Silicati*, **10** [5], 16–17; [7], 13–15; [10], 14–16 (1932).—E. concludes his description of the steps in modeling vases with a discussion of (1) the mechanical wheel whose velocity can be regulated, (2) modeling and casting by hand, (3) the use of liquid paste for casting, (4) the calibrating electric wheel and the column wheel, and (5) industrial automatic wheels. For Parts I to VI see *Ceram. Abs.*, **11** [8], 437 (1932). M.V.K.

Flowers for ceramic design. ANON. *Cold Storage*, **35**, 79 (1932).—A block of ice containing waratahs and other Australian flowers was dispatched by Doulton's Australian agent to Lambeth, in order to show pottery artists the true form and color of the flowers. H.H.S.

Is Satsuma a lost art? ROXEY M. MICKEY. *Design*, **34** [6], 141 (1932).—Imitations and increased cost of production are threatening the loss of the Satsuma art. Satsuma has tiny thread-like cracks covering the entire article. The best pieces are smooth and even, bright and shiny with smooth ivory colored bases. The colors are well blended and delicately applied in combination with fine gold lines. Illustrated. E.B.H.

Union for ceramic art. ANON. *Stavivo*, p. 294 (1932).—This Union was constituted on May 15, 1932, as a branch of the Czechoslovakian Ceramic Society. R.B.

Faience from Haban. K. CERNOHORSKY. *Zprávy Československ. keram. společnosti*, **8**, 165 (1931); abstracted in *Rev. mat. constr. trav. pub.*, No. 272, p. 92*B* (1932).—The production of faience objects was introduced by a religious sect of Czechoslovakian Anabaptists who adopted an absolute communism with respect to property. Toward the end of the 16th Century they attained great perfection in the manufacture of faience ware from a technical and artistic point of view, and exercised a predominant influence on the European ceramics of this time. The faience ware was called "Habany" by the Czechoslovakian people. It was ornamented with flowers executed in brilliant colors on white, cobalt blue, or yellow-gold glazes. The collections of great European museums contain numerous samples of faience ware from Haban. M.V.K.

Graffito painting in the Engadin, Switzerland. H. URBACH. *Tonind.-Ztg.*, **56** [95], 1170–71 (1932). W.M.C.

Excavations in Mexico. J. E. LODGE. *Popular Sci. Monthly*, **120** [4], 24–25 (1932).—Works of art unearthed in the ruins at Monte Alban by A. X. Caso, Mexican government archeologist, are described. Illustrated. See also *Ceram. Abs.*, **11** [7], 400 (1932). F.G.H.

Collections of peasant ceramic art at Brno. H. LANDSFELD. *Stavivo*, p. 53 (1932).—The Moravian Museum at Brno has installed an exposition of Moravian and Czechoslovakian peasant ceramic art and reconstructed ancient potteries. R.B.

Medieval glass. ANON. *Illus. London News*, **181**, 617–18 (1932).—Colored reproductions of 13th Century windows from the Cathedral at Auxerre are given. H.H.S.

Ceramics in Ascoli Piceno. GIAN CARLO POLIDORI. *Corriere ceram.*, **13** [9], 335–41 (1932).—The production of ceramic ware at the Monastery of Saint Angelo in the 18th Century, and the work of Giacomo and Agostino Cappelli, the Paci family, and Matricardi are described. M.V.K.

Cult objects in Cyprus. EINAR GJERSTAD. *Illus. London News*, **181**, 452–56 (1932).—A terra cotta "congregation" of worshipers arranged in semicircles before an altar to an unknown god has been discovered by the Swedish expedition to Cyprus. H.H.S.

Ancient Sumerian civilization. HENRY FRANKFORT. *Illus. London News*, **181**, 502–505, 526–29 (1932).—The Oriental Institute of Chicago Univ. maintains 12 expeditions in the field. F. is field director of the Iraq expedition, the work of which is illustrated. Excavations at Khafage revealed a temple 5000 years old, and links of culture between Mesopotamia and ancient India were noted. H.H.S.

Treasures from Western Persia. A. U. POPE. *Illus. London News*, **181**, 613–15, 666–67 (1932).—Pottery, glass, and bronze found at Luristan, mostly by graduates of the American College at Teheran, show affinities with ancient China and with Mesopotamia. H.H.S.

Election "ballots" from ancient Athens. LESLIE SHEAR. *Discovery*, **13**, 368 (1932).—The "ballots" are pieces of earthenware on which the voter wrote a name. H.H.S.

A mosaic pavement from Antioch. C. R. MOREY. *Discovery*, **13**, 343 (1932).—The pavement was discovered by a Princeton expedition. 1 photograph. H.H.S.

BOOKS

Scheme of Egyptian Chronology. D. MACNAUGHTON. xii + 405 pp. Luzac, London, 1932. Price 25s. Reviewed in *Times Lit. Supp.*, **31**, 735 (1932).—Notes on Cretan and other chronologies are included. H.H.S.

Porcelain As an Art and a Mirror of Fashion. ROBERT SCHMIDT. 336 pp. Reviewed in *Times Lit. Supp.*, **31**, 814 (1932); for abstract see *Ceram. Abs.*, **12** [2], 69 (1933). H.H.S.

PATENTS

Design for pedestal lavatory. H. V. KOHLER AND F. G. BROTZ. U. S. 88,713, Dec. 20, 1932.

Design for shelf-back lavatory. GEORGE BRAIN (Standard Sanitary Mfg. Co.). U. S. 88,748, Dec. 27, 1932.

Design for bottle. W. M. MCCORMICK (McCormick & Co., Inc.). U. S. 88,737, Dec. 20, 1932.

Design for pitcher. C. M. EVANS (Bartlett-Collins Co.). U. S. 88,762, Dec. 27, 1932.

Design for gas range. HENRY LANGE (Quincy Stove Mfg. Co.). U. S. 88,878, Jan. 3, 1933.

Design for jar, etc. HENRY DREYFUSS (Capstan Glass Co.). U. S. 88,905, Jan. 3, 1933.

Design for plate, etc. A. C. SCAVULLO (New Yorker Hotel Corp.). U. S. 88,932, Jan. 3, 1933.

Decalcomania decorations. GEORGE R. ENSMINGER (E. I. du Pont de Nemours & Co.). U. S. 1,872,131, Aug. 16, 1932.

Decorating glazed ware. WESTERN BOHEMIA REFRACTORIES AND KAOLIN WORKS. Czechoslo. 7477, 1929; *Stavivo*, p. 181 (1931).—Color effects are obtained by laying colors emulsified in volatile fluids, *e.g.*, kerosene, on the glaze and volatilizing the fluid. The effects appear in place of the emulsion particles filled with air. R.B.

Cements

Researches on Portland cement and its components by vapor pressure measurements. F. KRAUSS, J. JÖRNS, AND W. SCHRIEVER. *Zement*, **21** [3], 31–36; [7], 89–93 (1932).—The question whether the hardening process is conditioned by colloid chemical processes or is due to the formation of crystallized products is discussed. The authors assume that both processes (formation of gel and formation of crystals) take place during hardening. The results of their researches are tabulated. See also *Ceram. Abs.*, **11** [5], 290 (1932). M.V.K.

Hardening of Portland cement. K. KOYANAGI. *Zement*, **21** [18], 257–58 (1932).—K. discusses the observations of Tippmann (*Ceram. Abs.*, **11** [5], 289 (1932)) on the hardening of Portland cement and compares them to his own. The chemical composition and optical properties of thin needle-like crystals appearing in Portland cement with a high surplus of water, and generally designated as calcium hydrosilicate, were determined exactly. They are not a hydrate of lime but calcium sulfoaluminate of the composition, $3CaO{\cdot}Al_2O_3{\cdot}3CaSO_4{\cdot}32.6\ H_2O$. M.V.K.

Changes in the setting time of Portland cement. PAUL SCHACHTSCHABEL. *Zement*, **21** [46], 643–47; [47], 658–61 (1932).—Experiments showed that slow setting occurs with a high moisture content and rapid setting with a low moisture content. The rate of setting depends on the formation of alkali carbonates and the decomposition of gypsum. M.V.K.

Iron cements and pozzuolanas. F. FERRARI. *Giorn. chim. ind. applicata*, **14** [10], 512 (1932).—The type of basic-siliceous cement of highest value, to which the iron Portland cement for mortars studied by F. belongs, has a hydraulic modulus of 2.20 to 2.30, and a siliceous modulus of 3.00 to 3.30. M.V.K.

Thermochemistry of Portland cement. O. FR. HONUS. *Stavivo*, p. 141 (1932); for abstract see *Ceram. Abs.*, **11** [3], 154 (1932). R.B.

Study of metallurgical Portland cements. I. P. DUMESNIL. *Rev. mat. constr. trav. pub.*, No. 278, pp. 441–48 (1932).—D. treats the following subjects: (1) history and definitions, (2) manufacture, (3) characteristics, (4) applications, (5) cost of production, and (6) metallurgical cements in France and abroad. M.V.K.

Rapid determination of hydraulic factors in cement and its raw materials. F. W. MEIER. *Zement*, **21** [20], 287–91; [21], 305–308 (1932).—(1) Through the utilization of the perchloric acid method for determining silica, the "oxin" method for determining the sesquioxides, and the filtration method for determining lime, the rapid determination of the hydraulic factors in cement and cement raw materials is easy and exact. (2) The filtration method given also permits the rapid determination of the magnesia and sulfuric anhydride contents so important for the properties of the finished product. M.V.K.

Studies on the hydrothermal synthesis of calcium silicates under ordinary pressure. VI. S. NAGAI. *Jour. Soc. Chem. Ind.* [Japan], **35** [10], 439–43 (1932).—In the study of the hydrothermal synthesis of a mixture of $2CaO:SiO_2$, N. found that the combination is poor at 800°C but gradually improves at 900 to 1000° and above. Monocalcium

silicate, $CaO \cdot SiO_2$, is best produced from CaO and SiO_2 by heating to 1200°C or above. Pure dicalcium silicate, $2CaO \cdot SiO_2$, can be produced from the mixture $2CaO : SiO_2$, or mixtures with a little larger lime content, by heating to 1250° or above. But $3CaO \cdot 2SiO_2$ is difficult to obtain in a pure state because it lies between the mono- and the dicalcium silicates and is very easily intermixed with them. When the mixing ratio of CaO to SiO_2 is kept strictly to 3:2 and the mixture is heated to 1250°C or above, a slightly purer product is obtained. For Parts IV and V see *Ceram. Abs.*, **12** [2], 82 (1933). M.V.K.

Contribution to the problem of hardening. KURT WÜRZNER. *Zement*, **21** [17], 243–45 (1932).—W. discusses the hardening of cement and describes his researches. It was found that the hydrosilicates, hydroaluminates, and hydroferrites of Portland cement are easily dissolved in concentrated calcium chloride solution and are precipitated as hydrate of lime, silica, iron oxide, and alumina in consequence of a hydrolytic cleavage. M.V.K.

Existence of tricalcium silicate. ERNST JÄNECKE AND R. BRILL. *Zement*, **21** [26], 380–81 (1932).—A discussion of researches on tricalcium silicate and β-dicalcium silicate is given. See also *Ceram. Abs.*, **10** [8], 543 (1931). M.V.K.

Progress of the cement industry in 1931. C. R. PLATZMANN. *Zement*, **21** [14], 197–202; [15], 213–18 (1932).—The achievements of the cement industry are reviewed including (1) standardization, (2) cement testing and analyses, (3) scientific research on cement, and (4) properties of cements. M.V.K.

Standard samples of cement. E. RENGADE. *Rev. mat. constr. trav. pub.*, No. 277, pp. 397–405 (1932).—A historical review is given of the attempts to standardize cement, including physical and mechanical tests and chemical analyses. M.V.K.

PATENTS

Manufacturing Portland cement. J. H. COLTON (Pacific Portland Cement Co.). U. S. 1,893,696, Jan. 10, 1933. The process comprises clinkering a cement mix containing alumina, lime, and silica to a clinker and recalcining the product.

Oxychloride cement compositions. M. CERVELLO. Brit. 384,043, Dec. 7, 1932.

Cementitious material of the high-alumina type. N. V. S. KNIBBS. Brit. 385,032, Dec. 28, 1932.

Enamels

Opacifying enamel in theory and practice. LUDWIG STUCKERT. *Glashütte*, **62** [45], 798–801 (1932).—Two different physical and optical phases are present in enamels, (1) the transparent colored or colorless enamels, and (2) opaque, nontransparent, white, or colored-opacified glasses. In the first case these phases are physically homogeneous, optically empty, with a regular reflection of light on their surface; to this group belong numerous colored and colorless transparent enamels, ground enamel for sheet metal, and majolica enamel on cast iron. In the second type of enamels the light permeability of the fusion (enamel) is removed by the intercalation of insoluble bodies having another optical density, or even gases. Physically and optically these enamels have heterogeneous systems. S. explains the physical laws of reflection using the equations of Fresnel. The intensity of the diffused light reflected by a powdery opacifier imbedded in an enamel depends on the number of surfaces of reflection, *e.g.*, thickness of the opacifier, pigment layer, or on the quantity imbedded. There is a maximum of opacity, however, with a definite addition of opacifier and a close relationship between the intensity of the light reflected and the dimensions of the pigment particles. A more or less strong absorption of light takes place also in the glaze and in the white pigment, besides the lateral dispersion due to the opacifier. Theoretically, there are several forms of opacifying. (1) The enamel batch contains ingredients which have higher indices of refraction of light and which are mechanically imbedded; this is the most frequent case. The opacifier is added to the mill. (2) Opacification is caused by substances precipitated in the glass, or by devitrification phenomena. Such an opacification is obtained in practice in powder enamels where the opacifier is melted with the batch, partly or completely dissolved, and then precipitated or separated on cooling. (3) Opacification is conditioned by phenomena of separation into component parts, *i.e.*, when two enamels mix easily at high temperatures but poorly at low temperatures. (4) The enamel fusion contains bubbles of gas very finely distributed (dispersed phase). This kind of opacification is well known in practice. In practice an opacifier must have a high refractive index and a

low solubility in the enamel fusion. The white oxides of metals of the 4th and some metals of the 5th group of the periodic system and a series of fluorides (cryolite, sodium fluosilicate, fluorspar) which dissolve in the enamel fusion and then separate on cooling comply with both conditions. There are two ways in which the opacifier is used, (1) mechanical imbedding in the enamel, and (2) melting or fritting with the raw enamel mixture. Both ways are described. The characteristics of the technical white opacifiers and pigments are as follows: (1) Tin oxide gives a warm ivory color tone. It is relatively insensitive to overfiring of the enamel, is almost completely dissolved in powder enamels, and precipitates in finely dispersed form on cooling. (2) Zirconium oxide is used as a basic silicate (Terrar, *Ceram. Abs.*, **10** [8], 547 (1931)). It gives a white opacification which sometimes turns bluish. (3) Antimony trioxide is used for powder enamels only. (4) Sodium meta-antimoniate (Leuconin, *ibid.*, **10** [8], 547; [11], 756 (1931)) is not poisonous and is used in the wet coating and in the powder methods. It is insoluble in the usual organic acids. Its opacifying action is similar to that of SnO_2. It is used as an addition to the mill or is melted with the enamel. It gives a pure white color. (5) Arsenic trioxide is the chief opacifier for ornamental enamels and is always melted in the batch. (6) Cryolite and sodium fluosilicate strengthen the action of the real opacifier and have a strong fluxing action on the enamel. They are always melted in the batch. The coloring opacifiers are Naples yellow (lead pyroantimoniate) and cadmium sulfide (CdS) for yellow, cadmium red or fire red (Cd (S, Se)) for red, iron oxide (Fe_2O_3) for red-brown, Thénard's blue ($CoO \cdot Al_2O_3$) for blue, new blue ($(Co, Zn)O \cdot (Al \cdot Cr_2)O_3$) for blue-green, chromium oxide (Cr_2O_3) for green, and chromic iron spinel ($FeO \cdot Cr_2O_3$, $(CO, Fe)O \cdot Cr_2O_3$) for black. M.V.K.

Investigating enamel in practice. I. ANON. *Glashütte*, **62** [33], 564–68; [38], 663–65 (1932).—Some testing methods are described by which the working properties and use of an enamel can be judged. These methods are based on the mathematical and experimental determinations of the physical properties. For complete knowledge of the melted enamel, the chemical analysis is fundamental. The physical and chemical properties, *i.e.*, specific gravity, tensile strength, resistance to pressure, elasticity, absolute hardness, specific heat, thermal conductivity, coefficient of expansion, coefficient of thermal resistance, and fusibility, depend not only on the composition of the enamel but also on the physical state, especially on the character of the crystals, condition of the stresses, and thermal history (melting time, melting temperature, granulation, firing temperature, and rate of cooling). Formulas are given and illustrated by examples. The significance of values determined mathematically is discussed. The experimental investigations, *e.g.*, determining the specific gravity and the coefficient of expansion, are discussed. Apparatus and methods used in practice for these experiments are described. M.V.K.

Progress of enamel technique. RICHARD ALDINGER. *Glashütte*, **62** [45], 793–95 (1932).—The use of boron considerably cheapens the enamel batch. It is used with success in white enamels in spite of a comparatively high iron content (about 2%). Lead compounds are being replaced by barium carbonate which improves the quality of the enamel. Majolica enamels become more lustrous and more resistant to atmospheric influences. The use of zinc oxide together with BaO is a good substitute for minium or litharge. German feldspar, pegmatite, and phonolite containing up to 78% SiO_2 can be used for all kinds of enamels. Lepidolite when ground fine can be directly applied on sheet iron without a ground enamel. Sodium silicate and a eutectic mixture of aluminum and sodium fluoride are used for producing glazes having a low melting point but a sufficient resistance to acids. Preparations of zirconium oxide and of the five-valent antimony oxide proved to be good opacifiers when used with suitable enamel batches. Special batches containing 10 to 20% zinc sulfide are used for the production of luminous enamel. Opaque enamels are obtained through large additions (25 to 80%) of feldspar, quartz powder, or alumina to the mill. It was also found that crystalline separations of sodium fluoride and calcium fluoride are the reasons for the opacification by cryolite or fluorspar, and that the loss of fluorine during firing is due to the sublimation of aluminum fluoride and sodium fluoride and the appearance of small quantities of hydrofluoric acid, and not to the escape of gaseous SiF_4. The different stages of the production of enamel, *e.g.*, grinding, sifting, drying, and firing, are discussed, and the importance of a systematic control in enamel production is pointed out. M.V.K.

Elimination of blistering of enameled-iron number plates. W. J. SCOTT. *Jour. Amer. Ceram. Soc.*, **16** [2], 93–95 (1933).

Adherence of porcelain enamel. I. ANSON HAYES. *Ceram. Ind.*, **20** [1], 10–12 (1933).—H. explains simply the highly technical and complicated enameling processes. Although directed primarily to sheet-iron enameling methods the phenomena apply

largely to cast-iron enameling also. Requirements for adherence, methods of application, thickness of enamels, stresses in enamel coatings, adjustment of coefficient of expansion, effect of furnace types, and cleanliness of metal are discussed. W.W.M.

Control of ground-coat dipping weight. G. W. HOFSTETTER. *Enamelist*, **10** [3], 10 (1932).—H. shows the effect of variation in test plate surface on the weight per unit area of dry enamel carried. Some tests were carried out using freshly pickled test plates and previously enameled test plates. The results are presented. It is suggested that for uniform test plate surface, enameled plates be used for control of ground-coat dipping weight. W.W.M.

Stove enameling. W. DOMAN. *Brit. Ind. Finishing*, **1** [12], 290–92 (1931).—D. describes different types of automatic and semiautomatic systems of stove enameling and various types of ovens used by enamelers. M.V.K.

Flow tests and their importance. H. G. WOLFRAM AND H. E. CRAVEN, JR. *Amer. Enameler*, **5** [7], 3–6 (1932).—The authors point out that every enamel has a specific gravity and a viscosity at which it works best. With some enamels these must be regulated very closely. A simple flow test tube is described. Water is used to regulate the enamel slip density and an electrolyte for regulating the flow after the correct density is obtained. W.W.M.

Significance of the adherent oxides in grounding iron plate. A. THÜRMER AND G. GLASER. *Glashütte*, **60**, 477–79 (1930); *Chem. Zentr.*, **II**, 1268 (1930).—If a polished Fe wire is immersed in fused enamel the enamel does not adhere to it. The immersion point of the fused mass becomes reddish. The authors believe that the surface oxidation of Fe is of no importance for the enameling process. Fe_2O_3 is a better grounding oxide than NiO, but CoO is better than Fe_2O_3. The metal silicates seem to adhere directly to the metal. (*C.A.*)

Suggestions on nickel pickling. G. W. HOFSTETTER. *Better Enameling*, **3** [12], 9 (1932).—The use of a nickel bath in the pickling room following the ordinary pickling process is discussed. It prevents fishscaling and increases the adherence of enamel to metal. Repickling in the nickel bath a second time, however, has a tendency to cause copperheads. The composition of the nickel solution and its control and use are outlined. W.W.M.

Permanent mold castings. P. DWYER. *Foundry*, **60** [7], 18–21 (1932).—Electric furnace gray iron is poured in refractory lined metal molds. Refractory lining preparation and core-sand mixtures and binders are described. Illustrated. F.G.H.

Foundry practice in sanitary ware. LOUIS WOLFF. *Ceram. Ind.*, **20** [1], 22–25 (1933).—Unequal wall thickness in iron castings which are to be enameled causes trouble. Castings still hot from the enameling furnace are easily bent. The iron used in the foundry must be carefully selected. Smooth operation is essential and carbon, soot, dust, or sand specks must be guarded against. Acid-resisting enamelware can not be manufactured as rapidly as ordinary enamelware, as firing requires more time. This increases the cost of production. W.W.M.

Equipment for the cleaning of metal. XXIV. R. W. MITCHELL. *Metal Cleaning & Finishing*, **4** [12], 637–42 (1932).—The discussion of electrocleaning in acid solution by patented processes is concluded by the description of the Madsenell process, the Mason patent, the Packard Motor Car Co. processes, some foreign developments, and Schmutz's patent for removal of buffing compounds. For Part XXIII see *Ceram. Abs.*, **12** [2], 46 (1933). E.J.V.

Process for production of white enamel. Abstracted from "Notes on the German Chemical Industry," submitted by W. L. LOWRIE, *Ceram. Ind.*, **20** [1], 15 (1933).—Ordinary white enamels require about 15% of opacifier when free from fluorine and 6% of opacifier when fluorine is used. A new German process produces good white enamels without fluorine and with less than 6% of opacifier. The opacifier contains the salt of an unstable acid, *e.g.*, sodium nitrate or formate, added to the amount of 0.5 to 3% depending on the composition of the enamel. Boiling trouble during firing does not occur with these enamels. The exact composition of the opacifier is very important and must be worked out for each enamel. One enamel composition is given as follows: 240 g. borax, 410 g. potash feldspar, 30 g. saltpeter, 120 g. sodium carbonate, 30 g. calcium feldspar, and 170 g. quartz are fused together to produce 1000 g. of lump enamel which is crushed and ground with 60 g. of tinting substance and about 20 g. of zirconia opacifier containing about 1 g. of sodium nitrate or formate. W.W.M.

Notes on the fusibility of sodium silicate and the possibility of using it in enameling. A. DEBECQ. *Chim. & ind.*, **28** [5], 1114 (1932).—The fusing temperature of sodium silicate during its manufacture varies from 1250 to 1350° depending on whether it is a basic silicate (30 to 36% Na_2O) or siliceous (20 to 25% Na_2O). After cooling and crush-

ing, this vitreous silicate melts at 710 to 750° according to its Na_2O content. It can be advantageously used in enameling, facilitating the manufacture, fusion, and reactions between the constituents, and lowering the consumption of fuel. M.V.K.

Future of low-cost porcelain enamel house depends on enamel cost. ROBERT W. MCLAUGHLIN, JR. *Ceram. Ind.*, **20** [1], 25 (1933).—McL. states that enameled sheet steel will have to be furnished at a price of 15 to 25¢ per square foot if it is to be used extensively in the construction of houses in the $3000 class. W.W.M.

Early development of enameling in the United States. H. M. REED. *Better Enameling*, **3** [10], 4 (1932).—R. gives a brief outline of the development of enameling in the U. S. especially with reference to bathroom fixtures. W.W.M.

BULLETIN

Mechanical moving of all foundry loads. CLEVELAND CRANE & ENGINEERING CO. *Foundry*, **60** [11], 72 (1932).—Illustrations show the applications of tram rail to the pattern storage, molding floor, material storage, pouring stations, grinding department, and material storage yards. F.G.H.

PATENTS

Enameling furnace. C. A. DUTTON (Ferro Enamel Corp.). U. S. 1,891,919, Dec. 27, 1932.

Dental crown, coated on the front with enamel, made of noble metal or noble metal material, and process for its production. RUDOLF HEJCMANN. U. S. 1,892,490, Dec. 27, 1932.

Tiled wall, etc. O. E. GRIGSBY (Porcelain Tile Corp.). U. S. 1,892,885, Jan. 3, 1933.

Removing enamel from a metal base. C. S. HOUPT. U. S. 1,892,950, Jan. 3, 1933. The method comprises immersing the base in a heated bath of caustic soda solution, the bath reacting with the enamel to remove it and to form a sludge, separating a portion of the bath during the deënameling operation, removing the sludge from such separated portion by centrifugal action, returning the clarified portion of the solution to the bath, and discarding the sludge whereby the deënameling process may be carried on continuously.

Process of manufacturing glazes or enamels. T. GOLDSCHMIDT AKT.-GES. Brit. 384,538, Dec. 14, 1932.

Method of producing enamelware. O. HOMMEL. Brit. 385,221, Dec. 28, 1932.

Frits for the production of enamels. I. KREIDL. Brit. 375,670, July 6, 1932; see also Brit. 375,672, *Ceram. Abs.*, **11** [10], 518 (1932). (*B.C.A.*)

Opacifying agents for enamels and glazes. IGNAZ KREIDL. Austrian 128,847, Feb. 15, 1932. Use is made of synthetically prepared silicoaluminates of the alkali and alkaline earth metals. Compounds containing 1 mol. of alkali or alkaline earth oxide to 2 mol. of SiO_2 are preferred. (*C.A.*)

Opacifying agents for zirconium enamels. IGNAZ KREIDL. Austrian 128,848, Feb. 15, 1932. Use is made of products obtained by heating Zr silicates with alkalis or alkaline earths, preferably in such proportions that substantially no free alkali or alkaline earth remains. (*C.A.*)

Opacifying enamels. IGNAZ KREIDL. U. S. 1,849,192, March 15, 1932.

Opacifying agents for enamels and glazes. IGNAZ KREIDL. Austrian 128,849, Feb. 15, 1932. Use is made of compounds of such metals and metalloids as form white oxides stable at glowing heat. The compounds are prepared for use by bringing them into the colloidal state and then heating in the presence of C or a compound yielding C. An example is given of the preparation of an opacifying agent from kaolin. Known opacifying agents are improved by the treatment described. See preceding abstract. (*C.A.*)

Decorating enameled articles. AKT.-GES. DER EMAILLIRWERKE UND METALLWAARENFABRIKEN AUSTRIA. Austrian 129,106, Dec. 15, 1931. Clouded effects are produced by applying a moist glaze, *e.g.*, by dipping, and superimposing on this, by means of a spraying pistol worked with air of at least 2 atmospheric pressure, a moist glaze of a different color. (*C.A.*)

Enamel. IGNAZ KREIDL. Fr. 725,509, Oct. 31, 1931. A charge of fused enamel, particularly for white opaque enamels, is of such a chemical composition that the frit is colloidal in the slip or presents a fine division approaching that state. This is effected by increasing the content of F as a F compound other than cryolite. The Al content is also increased by the addition of clay, etc. The content of boric acid is reduced and that of Na_2CO_3 increased. (*C.A.*)

Enamels and glazes. IGNAZ KREIDL. Fr. 726,552, Nov. 19, 1931. In making enamels or glazes which are rendered opaque by agents liberating gases, the agents are used in combination with frits which possess in the slip a colloidal form or a finely divided state approaching the colloidal form. (*C.A.*)

Yellow coloring materials for ceramics and enamels. DEUTSCHE GOLD- UND SILBER-SCHEIDEANSTALT VORM. ROESSLER. Fr. 727,012, Nov. 28, 1931. White oxides stable to calcination and suitable as opacifying agents, such as SnO_2 and ZrO_2 or mixtures of these, are calcined with small quantities of oxides of V or Mo or both or compounds of these elements which form oxides on heating. Small quantities of other oxides such as SiO_2, TiO_2, Al_2O_3, etc., which increase the resistance to fire or the richness of the shades, may also be added. (*C.A.*)

Enameling iron bathtubs, etc. G. HUTH. Ger. 548,584; *Emailletech. Monats-Blätter*, **8** [11], 83 (1932). The method for enameling cast-iron objects consists of using an electric muffle kiln mounted so as to be rotatable and swung around in the same manner as the table usually used for dusting on enamel in powder form, and having a removable top which permits the dusting on of the enamel in the furnace, thus maintaining the object at a more even temperature and not wasting so much heat. E.J.V.

Furnace for firing enamel. CARL THIEL. Ger. 551,819, March 3, 1929. (*C.A.*)

Glass, enamels, etc. PAUL BEYERSDORFER. Ger. 554,027, May 21, 1931. In the manufacture of glass, enamels, frits, and glazes containing Pb, metallic Pb is added to the mixture of initial materials in association with an amount of oxidizing agent, *e.g.*, a nitrate, sufficient to oxidize the Pb to PbO when the initial mixture is fused under oxidizing conditions. Various details and an example are given. (*C.A.*)

Enamel and glaze. IGNAZ KREIDL. Ger. 554,517, Sept. 1, 1929. White clouded enamel or glaze is produced on articles by clouding the fused enamel or glass with gas. An absorbing agent is added with the clouding agent, and by varying their relative amounts, various effects are produced. Organic dyes may be added. Examples are given in which methylene blue, HNO_3, and HCOOH are the gas-forming agents. (*C.A.*)

Enameling iron, etc. WILHELM UEBEL (I. G. Farbenind. A.-G.). Ger. 555,477, Feb. 16, 1929. Metals are enameled, to give them the appearance of pottery or stoneware, by applying a ground enamel of appropriate color and a translucent covering enamel which is less difficultly fusible than the ground enamel and of a different color. (*C.A.*)

Glass

Volatilization and vapor tension at high temperatures of the sodium silicate-silica glasses. E. PRESTON AND W. E. S. TURNER. *Jour. Soc. Glass Tech.*, **16** [63], 331–49 (1932).—Employing the method previously described (*Ceram. Abs.*, **11** [12], 610 (1932)) the volatilization losses from a series of 7 glasses containing soda and silica between the limits 48.85 Na_2O, 51.15 SiO_2, and 11.83 Na_2O, 88.17 SiO_2 were determined at temperatures ranging from 1100 to 1400° for different periods of time. At 1400°, the losses in 20 hr. from these two glasses were 48.0 and 2.6 mg./sq. cm., respectively; while from the first glass at 1400, 1300, 1200, and 1100° the corresponding losses were 48.0, 20.0, 8.0, and 2.6 mg./sq. cm. The rate of loss of Na_2O, even from the glass containing 48.85 Na_2O, was thus far less than that (236 mg./sq. cm. in 20 hr.) from the alkali-lead oxide (30%)-silica glass previously studied. The vapor tensions of glasses containing 48.84 and 44.58 Na_2O were 2.20 mm. Hg, and 1.35 mm. Hg, respectively, at 1350°, 1.37 and 0.85 mm. at 1300°, and 0.56 and 0.35 mm. at 1200°. The ratios of the vapor tensions and of the volatilization losses of these two glasses were shown to be the same. If the losses are plotted against Na_2O content for different periods of heating, the curves consist in each case of two intersecting straight lines indicating that the molten glasses are not constituted of Na_2O and SiO_2 as products of dissociation, but consist of a mixture of metasilicate and disilicate when the Na_2O exceeds 34% and of disilicate and silica when less than 34% Na_2O is present. Confirmatory evidence of this interpretation was derived from the temperature coefficients of volatilization of the 7 glasses and from the results of the study of the relationship $\frac{10^6}{t} \log \frac{(A-2x)}{A} = K$. G.R.S.

Calculation of the densities of glass. W. Biltz and F. Weibke. *Glastech. Ber.*, **10** [10], 577–93 (1932); for abstract see *Ceram. Abs.*, **11** [2], 89 (1932). W.W.B.

X-ray absorption of some glasses. M. Tanaka. *Mazda Research Jour.* [Tokyo], **6** [2], 115–21 (1931).—X-ray absorption coefficients for Na_2O–CaO, Ba, K–Pb, and CaO glasses are recorded. (*B.C.A.*)

Behavior toward β- and γ-rays of alkali glasses which contain Cl^-, F^-, and SO_4^{--}, as well as manganese glasses with and without iron salts. Josef Hoffmann. *Sitzber. Akad. Wiss. Wien, Math.-naturw. Klasse*, Abt. IIa, **141**, 55–62 (1932).—About 40 different glasses were exposed to β- and γ-radiations and were then heated until the irradiated color disappeared or became constant. Tables are given showing the composition, initial and irradiated colors, and the time and temperature of the treatments. The yellow to brownish color of silicate glasses, which is due to alkali metal atoms, changes with the concentration toward blue and violet. It was found that this blue or violet coloration is not due to alkali metal atoms. Mn glasses which gave a red color on irradiation contained Mn^{III} or Mn^{IV}; violet proceeded from Mn^{III} and Mn^{II}. A glass containing Mn^{II} with high Fe gave a gray color; without Fe it was not colored. (*C.A.*)

Constitution of glass. I. W. Weyl. *Glashütte*, **62** [48], 853 (1932); for abstract see *Ceram. Abs.*, **12** [2], 48 (1933). M.V.K.

Temperature dependence of absorption of colored glasses and its significance. G. Kiltz. *Glashütte*, **62** [48], 853 (1932).—The changes of properties of glasses and the anomalies of the softening interval with increased temperature are of special interest for the glass investigator. The study of the spectrum absorption of colored glasses has increased the knowledge of these questions. A method of measuring the absorption at different temperatures is described. The changes are due partly to purely physical reasons (partial deformation of electron tracks with increased atomic distance) and partly to chemical processes occurring in the glass. The study of these processes is of special interest because it has been possible to freeze up different equilibriums of dissociation by sudden cooling at different temperatures. M.V.K.

Decreasing the iron content of glasses decolorized with selenium. Emilio Damour and Alexander Nadel. *Chim. & ind.*, **28** [6], 1283–88 (1932).—The observation of the volatilization of iron, probably in the form of chloride, has given a satisfactory explanation of all phenomena in which the action of sodium chloride varies. The volatilization in the form of iron chloride is probable. $FeCl_3$ has a low boiling point (280°). Its formation in this case is due to a catalytic action of selenium, sodium chloride furnishing an equivalent amount of chlorine. The high temperature of the reaction is favorable to the formation of $FeCl_3$, whose heat of formation is 192.080 cal. The conception of a formation of complex compounds of iron and selenium in which sodium chloride has a certain action has been abandoned. It seems that an equilibrium is established which does not permit the reaction to exceed a certain limit. This reaction is reversible and must depend on the law of action of masses ($3NaCl \rightleftharpoons FeCl_3$) and the rule of phases. A progressive weakening of the catalyzer must also be taken into consideration. The theory of the volatilization of iron as chloride explains the different phenomena of coloration and decoloration in experimental melts. The practical results of this study show the great advantages of combining selenium and sodium chloride for decolorizing glass, which are as follows: (1) Because a part of the iron has volatilized, the glass is enobled and its decoloration is rendered more easy and more stable. (2) Smaller quantities of selenium are required. (3) Sand of lower quality and having a somewhat higher iron content can be used with success for the production of a colorless glass. M.V.K.

Determination of the light transmission of glassware for structural purposes. A. Vašíček. *Slavivo*, p. 41 (1932).—Ulbricht's sphere is used for measuring light transmission and for the determination of spherical lighting effect of incandescent bulbs (*Sprechsaal*, p. 333 (1926); p. 565 (1928)). In a height of about $^1/_8$ of the radius, the upper part of this sphere is cut off and the test specimens are placed in this opening in two-piece frames. A homogeneous light is placed over the specimen. Transmission of light is expressed by the ratio

$$a = \frac{S}{S'} = \left(\frac{r'}{r}\right)^2 \quad \text{or} \quad 100\left(\frac{r'}{r}\right) \ 2\%$$

S is the lighting effect of the opening of the sphere, S' the effect of the opening covered with the specimen, r the distance of the photometer from the source of light for the lighting effect S, and r' the photometer distance for the effect S'. Results obtained by using this method are accurate to 2 to 3%. R.B.

Temperature variation of the thermal conductivity of Pyrex brand glass. R. W. B. STEPHENS. *Phil. Mag.* [Supp.], **14** [94], 897 (1932).—The thermal conductivity of Pyrex brand glass in the form of capillary bore tubing was measured over a temperature range from −180 to 250°C. Heat was applied by electric current through a platinum wire sealed into the center of the tube, the tube being immersed in an oil bath and wrapped with a platinum resistance thermometer. Correction was made for the resistance of the liquid contact films. The data indicated that the thickness of the film is proportional to the logarithm of the viscosity of the liquid. The variation of conductivity of the glass could be expressed by the equation, $K = A + b\log_{10} T$, where A and b are constants having the values -0.00352_3 and 0.00245_4, respectively. K is expressed in cal. centimeter^{-1} second^{-1} degree^{-1}, and T is the absolute temperature. The variation of conductivity in the range 0 to 100 is almost linear and can be expressed by the equation, $K = K_0(1 + \alpha t)$. $\alpha = 0.00133$ per °C. J.T.L.

Enamel coatings on glass. FRANZ SKAUPY. *Glastech. Ber.*, **9** [6], 345–49 (1931).—S. discusses in detail the researches made by the Osram Co. on the use of enamel coatings for incandescent lamps. The physical and chemical properties of the enamel, *i.e.*, the melting point, coefficient of expansion, and chemical resistance, must fulfill certain requirements. Different enamels were examined. (1) System, PbO–TiO_2–B_2O_3. The temperature of sintering is the same as in lead-borate systems with the same B_2O_3 content, but the yellow coloring is weaker. The chemical resistance is improved when using the same content of boron. The system is inclined to a greater devitrification and reduction during the firing of the enamel (gray coloring). (2) PbO–Bi_2O_3–B_2O_3. The temperature of sintering is increased and the chemical resistance is lowered while the coefficient of expansion and yellow coloring are scarcely changed. (3) PbO–PbF_2–B_2O_3. The sintering temperature is lowered, the coefficient of expansion is increased, and there is a tendency toward reduction, devitrification, and disintegration. (4) PbO–ZnF_2–B_2O_3. Similar to (3). (5) PbO–Al_2O_3–B_2O_3. The change in properties was not determined with certainty. (6) PbO–MgO–B_2O_3. Similar to (5). (7) PbO–SiO_2–B_2O_3. The chemical resistance is improved but the sintering temperature is increased. (8) PbO–ZnO–B_2O_3. The best results were obtained with this system. The sintering temperature rises with increasing zinc content, but much less than when using other oxides. The coefficient of expansion is considerably lowered, the chemical resistance is heightened, and the yellow coloring is weakened. Zinc borates with 60 to 75% PbO, 10 to 25% ZnO, and 15 to 30% B_2O_3 were found especially suitable. (9) PbO–ZnO–ZnF_2–B_2O_3. The ZnF_2 as a substitute (in part) for ZnO lowers the sintering temperature, but increases the coefficient of expansion and the inclination to reduction. (10) PbO–ZnO–BaO–B_2O_3. No improvement over the PbO–ZnO–B_2O_3 system was noted. (11) PbO–ZnO–SiO_2–B_2O_3. The introduction of SiO_2 did not improve the enamel. The following points are also discussed: (*a*) coloring and opacification of the enamel, (*b*) its production and coating on glass, and (*c*) fields of application of enamel coatings on glass. See also *Ceram. Abs.*, **10** [12], 821 (1931). M.V.K.

Determination of soluble silicates in glass. J. RAE. *Pharm. Jour.*, **129**, 289 (1932).—The glass is powdered and boiled with H_2O, and SiO_2 is determined by the NH_4 molybdate method. Results are given for various glasses. During storage in glass bottles, distilled H_2O dissolves slight traces of SiO_2; 0.1 *N* NaOH dissolves more SiO_2, but 0.1 *N* H_2SO_4 has no solvent effect. (*B.C.A.*)

Method of analysis of glasses, especially in regard to rapid determination of alkalis. A. NOEL. *Ing. chim.*, **16**, 38–48 (1932); for abstract see *Ceram. Abs.*, **12** [2], 52 (1933). (*C.A.*)

Transmissive properties of tinted lenses. W. W. COBLENTZ. *Amer. Jour. Ophthalmology*, **15** [10], 932–41 (1932).—The essential facts of the tinted-lens question are given and the subject is clarified and simplified showing what tinted lenses can and can not do in transmitting light.

Safety glass which eliminates harmful rays. ANON. *Nat. Glass Budget*, **48** [36], 3 (1933). E.P.R.

Acetylcellulose in safety glass. FRITZ OHL. *Kunststoffe*, **22**, 179–81 (1932); for abstract see *Ceram. Abs.*, **11** [6], 357 (1932). (*C.A.*)

Safety glass. A. BRESSER. *Chem. App.*, **19**, 62–64 (1932); for abstract see *Ceram. Abs.*, **11** [5], 300 (1932). (*C.A.*)

Quartz glass and its manufacture. B. IBAKH. *Keram. i Steklo*, **8** [8], 9–12 (1932).—The chief properties of a quartz object are (1) an extremely small coefficient of expansion which gives it considerable stability to sudden changes of temperature; (2) a high resistance to chemical attack; (3) good insulating qualities (better than porcelain) maintained during heating and in damp atmosphere; (4) maintenance of this

insulating capacity in a high-frequency current; (5) a large interval of transparency (from the extreme infra-red rays to the short wave of the ultra-violet rays). Rock crystal, quartz sand of high purity, and especially vein quartz are suitable raw materials. The mechanical homogeneity of the batch is of great importance. I. describes methods used for manufacturing quartz glass objects developed by the Institute of Metals and patented abroad. M.V.K.

Triple lens telescope to help blind. WILLIAM FEINBLOOM. *Amer. Glass Rev.*, **52** [13], 16–17 (1933).—"Telescopic parallax" is the term used to designate the apparent displacement of the object seen through the telescope. Thus by deliberate distortion of a small part of the image, the beholder's impression of displacement is destroyed and he can see the object in its proper spatial relationship. The distortion in the instruments worked out by F. consists of a horizontal magnification. E.P.R.

Curved "invisible" glass tests described by British architect. ROBERT HOWDEN. *Amer. Glass Rev.*, **52** [15], 19 (1933).—The method is to curve the surface of the glass pane so that reflections of objects in front of it are not seen. Freed from these reflections, the glass itself becomes virtually invisible. E.P.R.

Using urtite in glassmaking. V. V. VARGIN AND N. B. ZHUK. *Keram. i Steklo*, **8** [8], 6–9 (1932).—Mineralogically, urtite is almost a pure nepheline and contains 85% nepheline, 5% apatite, and 10% dark colored minerals. It is obtained in large amounts in the working of apatite deposits of the Murman (north Russia). The alkali content of urtite amounts to 17 to 21%, while nepheline syenite contains only 11 to 15%. The ratio of the alumina to the alkali content averages about 1.43 in urtite (nepheline syenite, 1.60). Experimental melts of urtite glass were melted in fireclay crucibles at the Lomonossov's glass plant. The composition of these glasses was as near as possible to that of the industrial nepheline glasses. Two series of melts, of 9 glasses each, were made. It was found that urtite glass melts more rapidly than nepheline glass, is less viscous, and is refined more easily, and that urtite dissolves in the melt better than nepheline. Urtite glasses tend to devitrify much less than nepheline glasses. M.V.K.

Notes on the manufacture of special glasses. X. Colorless glasses. ANON. *Glass*, **9** [12], 512–16 (1932).—A discussion is given of the use of special ingredients added to the batch or to the melt intended to accelerate the rate of fining or to act in such a manner as to clear the glass of residual seed. The ingredients considered are (1) arsenic, (2) antimony oxide, (3) ammonium salts, (4) borax, (5) niter, and (6) saltcake. For Parts VIII and IX see *Ceram. Abs.*, **12** [2], 51 (1933). G.R.S.

Calcium fluoride as a purification agent and its influence on certain bottle glasses. F. DE CARLI. *Ann. chim. applicata*, **22** [6], 479–83 (1932); abstracted in *Chim. & ind.*, **28** [6], 1369 (1932); for abstract see *Ceram. Abs.*, **12** [2], 52 (1933). M.V.K.

Opal glass. J. W. RYDE, B. S. COOPER, AND W. A. R. STOYLE. *Pottery Gaz.*, **58** [667], 76 (1933).—A modified theory of light diffusion is described and results are presented in a graphical form, showing how it may be applied so as to take account of various dimensional changes and assess the intrinsic merits of different glasses. Various methods of measurement used in experimental work and the results obtained, as well as proposals for establishment of figure of merit for opal glasses, are described. E.J.V.

Manufacture of opal glass. W. M. HAMPTON. *Pottery Gaz.*, **58** [667], 76–77 (1933).—H. outlines certain phases of development in connection with the manufacture of British opal glass which have occurred during the last few years. E.J.V.

Eternal problem of seed. F. W. NOEL. *Glass Ind.*, **14** [1], 1–3 (1933).—A discussion of the causes leads to the conclusion that the best conditions of seed elimination are gained when (1) the loss in melting is about 15%, (2) the raw materials are carefully graded, (3) the moisture content is kept strictly under control, (4) the batch is uniformly fed, if not continuously, at least at regular short intervals of time, and (5) when proved accelerators are added to the batch. Ammonium sulfate is recommended as being the most beneficial, preferably with borax. Arsenic may be used only as far as it concerns the color of the glass. E.J.V.

New problems of glassmelting. M. A. BESBORODOV. *Keram. i Steklo*, **8** [9], 23–25 (1932).—B. discusses the rationalization of glassmelting and the necessity of studying (1) all physical and chemical processes taking place during melting, (2) the microscopic structure of melts at different temperatures, (3) the appearance and disappearance of bubbles and striæ, (4) the equilibrium systems of binary, ternary, and multicomponent systems, and (5) electrical melting of glass. M.V.K.

Scientific experimental work of the State Experimental Institute for Glass in the second five-year plan. I. I. KITAIGORODSKII. *Keram. i Steklo*, **8** [9], 19–23 (1932).—

The report deals with the development of the glass industry, raw materials, researches on glass, and refractories. M.V.K.

Decolorizing glass. F. BAUER. *Glashütte*, **62** [33], 559–61 (1932); this is the original reference, for abstract see *Ceram. Abs.*, **12** [1], 14 (1933). M.V.K.

Glass as industrial material. HANS JEBSEN-MARWEDEL. *Umschau*, **36** [49], 973–75 (1932).—J. describes the successive stages of the manufacture of glass, treating raw materials, mixing, melting, refining, and cooling. M.V.K.

Glass mosaic for Rockefeller Center. R. G. SKERRETT. *Glass Ind.*, **14** [1], 4–7 (1933).—"Intelligence Awakening Mankind" is the title Barry Faulkner has chosen for the great mosaic designed for the RCA Building in Rockefeller Center, New York City. This decoration is 14 ft. high by 79 ft. in length. The details of making glass mosaics are given. Illustrated. E.J.V.

Glass in decorative schemes. M. L. ANDERSON. *Pottery Gaz.*, **58** [667], 75–76 (1933).—In pointing out ways in which glass of various kinds might be put to greater use in schemes of decoration, A. takes up the following points: (1) how glass is made, (2) what it is, (3) how its properties can be used in a decorative way, *e.g.*, for lighting as well as for ornament, and (4) the various treatments available for obtaining the effects desired. E.J.V.

Old English glasses. No. 37. Jelly glasses. F. BUCKLEY. *Glass*, **9** [12], 521–22 (1932).—Jelly glasses showed some relationship to the wineglasses of their period. They probably acquired their characteristic bell shaped bowl soon after 1713, and retained it to the cut glass period. Jelly glasses are nearly always of good quality and excellent metal. A number of photographs are shown. For No. 36 see *Ceram. Abs.*, **12** [2], 57 (1933). G.R.S.

Famous glass mosaics of Saint Sophia uncovered. ANON. *Glass Ind.*, **14** [1], 3 (1933).—Thomas Whittemore, director of the Byzantine Institute of America, has been cleaning the surface adornments of Saint Sophia in Constantinople. These famous decorations elaborately treated in mosaic dating from Byzantine times are among the most beautiful of their kind in the world. In six months nine decorations in the Narthex were uncovered. E.J.V.

Technique of glasspot arching and melting practice. JOHN M. NEFF. *Ceram. Ind.*, **20** [1], 13–15 (1933).—N. states that there should be two sets of furnaces in a glass plant, one for drying and preheating the pots to about 1800°F and the other for the glassmelting. This preheating of pots is discussed at length. An efficient type of arch is described. The burners are staggered on opposite sides of the furnace. Transfer of the pots to the melting furnace and setting them is described. Coal screenings are used in place of sand for leveling off the seat for the pot. Precautions which will increase the life of pots are given. W.W.M.

Mathematical and analytical considerations on oil-fired tank furnaces. II. HOROWITZ. *Glashütte*, **62** [46], 817–18; [47], 834–36; [48], 849–52; [49], 866–70 (1932).—A mathematical method for determining with sufficient exactness the thermal charge, fuel consumption, and losses for the melting output for recuperative oil-fired tanks is given. Data and numerical values necessary for analogous calculations are compiled. Curves and diagrams obtained for two different tanks are given. The character of the curves obtained for different oil-fired tanks is always the same. From the similarity of these diagrams it can be assumed that a uniform fundamental law should exist for recuperative oil-fired tanks. The fuel consumption as a function of the melting output follows a hyperbolic law. The optimum thermal charge depends exclusively on the construction of the tank and remains constant for different kinds of batches. For Part I see *Ceram. Abs.*, **12** [2], 57 (1933). M.V.K.

Economy in glass manufacture. Raw materials and fuels. ANON. *Amer. Glass Rev.*, **52** [8], 11–12 (1933). E.P.R.

Homogenization of the mixture. III. Influence of moisture in sand on the ease of mixing the batch. F. ECKERT, S. DEL MUNDO, AND F. H. ZSCHACKE. *Sprechsaal*, **65** [47], 840–41 (1932).—The investigation shows that up to 5% moisture in the sand makes the homogenization easier, but that greater amounts increase the time required for complete mixing. For Part II see *Ceram. Abs.*, **10** [12], 832 (1931). W.W.B.

Cast iron glasshouse molds. ANON. *Foundry*, **60** [5], 57 (1932).—Compositions and casting methods for cast iron glasshouse molds are described. F.G.H.

Unit for cracking-off, grinding, and glazing tumblers. ANON. *Amer. Glass Rev.*, **52** [9], 14–15 (1933).—An illustration shows the complete system including the new cracking-off machine, the Knight grinder, and the Knight "long" glazer. E.P.R.

Sandblast and its use in finishing glass. U. LOHSE. *Eng. Progress*, **13** [12], 261–64 (1932); for abstract see *Ceram. Abs.*, **12** [2], 51 (1933). J.L.G.

Silicosis in crucible makers in the glass industry. K. STETTER. *Zentr. Gewerbehyg. Unfallverhütung*, **19**, 6–11 (1932).—A study was made of 900 glass grinders. The condition does not develop rapidly but is marked after 20 to 30 years' exposure. (*C.A.*)

Progress of the glass industry in 1931. OSCAR KNAPP. *Glashütte*, **62** [37], 642–43 (1932).—K. discusses the melting of glass, glass defects due to melting, and annealing according to the investigations of (1) Bailey (*Ceram. Abs.*, **10** [11], 762 (1931)), (2) Gehlhoff (*ibid.*, **10** [7], 491 (1931)), (3) Bowmaker and Cauwood (*ibid.*, **10** [10], 685 (1931)), (4) Marden (*ibid.*, **10** [10], 685 (1931)), (5) Rosenfeld (*ibid.*, **11** [1], 16 and 17 (1932)), (6) Eckert and Zschacke (*Sprechsaal*, **64** [13], 243 (1931)), (7) Dietzel (*Ceram. Abs.*, **11** [7], 407 (1932)), (8) Nováky (*ibid.*, **10** [11], 765 (1931)), (9) Pesserl (*ibid.*, **10** [8], 556 (1931)), (10) Guss (*ibid.*, **11** [8], 447 and 450 (1932)), and (11) Rolf (*Keram. Rund.*, p. 449 (1931)). See also *Ceram. Abs.*, **11** [11], 563 (1932). M.V.K.

BOOK AND BULLETINS

Pot Furnaces for Melting Glass. (Gorshkovuie Stekloplavilnuie Pechi.) S. S. BERKMAN. State Chemico-Technical Publication, 1932. 64 pp. Reviewed in *Keram. i Steklo*, **8** [9], 30 (1932).—This book is a description of glassmelting in pot furnaces and is written for nonprofessionals. M.V.K.

Publications on glass technology and standard samples of interest to the glass industry. ANON. Bur. Stand. *Letter Circ.*, No. 350. Free. This circular lists all publications dealing with glass that have been issued by the Bureau and represents a revision of a similar circular previously issued. R.A.H.

Selenium ruby glass. K. FUWA. *Intern. Illumination Congress, Gt. Britain* [*Birmingham*], 8 pp. (Sept., 1931); *Sci. Abs.*, **35B**, 147 (1932).—The effects of time and temperature of reheating and of constitution on the color of Se glass are described. Spectrophotometric measurements are given for a number of specimens which were subjected to various heat treatments. The contents of Se and CdS in the glass must be more than 0.2% each and the sum of the two must be more than 1.0%. Lead glass alone is unsuitable for producing Se ruby glass, and the more easily the glass is melted, the more easily its color is developed on reheating. (*C.A.*)

Soda ash booklet. COLUMBIA ALKALI CORP. *Ceram. Ind.*, **19** [6], 298 (1932).—The booklet is obtainable from *Ceramic Industry*. W.W.M.

Book Review

Influence of Alumina and Magnesia on the Crystallizing Capacity of Glasses. I. I. KITAIGORODSKII. 85 pp. Price 1R. 50k. Moscow, 1928. On the basis of some previously published conclusions (*Ceram. Abs.*, **8** [8], 569 (1929)) K. recommends one of the following compositions which will melt at the lowest temperature for the manufacture of Fourcault glass on a commercial scale:

Number	SiO_2	R_2O	Ca	+	Al_2O_3
311	6	1.0	0.8		0.2
313	6	1.0	0.7		0.3
356	6	1.2	0.7		0.3
360	6	1.3	0.7		0.3
362	6	1.4	0.9		0.1
363	6	1.4	0.8		0.2

Glasses 311 and 313 will probably decrease the output of the tank furnace due to their lower alkali content. The most suitable glass is 360. In introducing new compositions, Numbers 362 and 363 should be used first. The book is concluded with an appendix containing well reproduced photomicrographs of cristobalite, tridymite, wollastonite, and pseudowollastonite. S. I. PERKAL

PATENTS

Method and apparatus for manufacturing glass. EDWARD DANNER. U. S. 1,891,370 to 1,891,373, Dec. 20, 1932. A. D.-H. CHAN (Soc. anon. des manufactures des glaces et produits chimiques de Saint-Gobain, Chauny, et Cirey). U. S. 1,892,458, Dec. 27, 1932.

Heat-insulated refractory for molten glass containers. K. E. PEILER (Hartford-Empire Co.). U. S. 1,891,604, Dec. 20, 1932.

Glassworking apparatus. W. H. WOOD. U. S. 1,891,792, Dec. 20, 1932.

Suction gathering forming machine. K. E. PEILER (Hartford-Empire Co.). U. S. 1,891,896, Dec. 20, 1932.

Means for manufacture of laminated glass. A. W. HORNIG. U. S. 1,891,931, Dec. 27, 1932.

Method and means for working glass. JAMES BAILEY (Corning Glass Works). U. S. 1,892,126, Dec. 27, 1932.

Process for drawing a glass band from the surface of the molten glass metal. BERNHARD ENGELS. U. S. 1,892,459, Dec. 27, 1932.

Control of heat conditions in glass furnaces. EUGENE GENTIL. U. S. 1,892,462, Dec. 27, 1932.

Glassworking machine. D. E. GRAY (Corning Glass Works). U. S. 1,892,463, Dec. 27, 1932.

Manufacture of wire net glass and apparatus therefor. JOSEPH GASKELL (Pilkington Brothers, Ltd.). U. S. 1,892,488, Dec. 27, 1932.

Method and apparatus for feeding molten glass. G. E. HOWARD (Hartford-Empire Co.). U. S. 1,892,765, Jan. 3, 1933.

Manufacture of drawn glass. I. O. PEDERSEN. U. S. 1,892,806, Jan. 3, 1933.

Apparatus for conditioning molten glass. A. J. SMITH (Hartford-Empire Co.). U. S. 1,893,063, Jan. 3, 1933.

Apparatus for cutting flat glass. F. E. SLOCOMBE (Pilkington Brothers, Ltd.). U. S. 1,893,658, Jan. 10, 1933.

Polishing glass. J. W. CRUIKSHANK (Pilkington Brothers, Ltd.). U. S. 1,893,985, Jan. 10, 1933.

Glassfeeding machine. J. F. DOWLING (Owens-Illinois Glass Co.). U. S. 1,894,030, Jan. 10, 1933.

Method and apparatus for producing glass articles. L. D. SOUBIER (Owens-Illinois Glass Co.). U. S. 1,894,069, Jan. 10, 1933.

Method and apparatus for making glass tubes. AUGUST KADOW (Owens-Illinois Glass Co.). U. S. 1,894,100, Jan. 10, 1933. ROBERT SALOMON. U. S. 1,894,201, Jan. 10, 1933.

Heating apparatus for glass furnaces. P. Q. WILLIAMS (Owens-Illinois Glass Co.). U. S. 1,894,249, Jan. 10, 1933.

Pot furnaces for glassmelting. J. SCHÜFFLER. Brit. 384,074, Dec. 7, 1932.

Manufacture of nonsplintering glass. CONSORTIUM FÜR ELEKTROCHEMISCHE INDUSTRIE GES. Brit. 384,153, Dec. 7, 1932.

Sheet glass making machines. NAAMLOOZE VENNOOTSCHAP MIJ. TOT BEHEER EN EXPLOITATIE VAN OCTROOIEN. Brit. 385,211, Dec. 28, 1932.

Ornamental glass. GEORGE A. SCHRAMKO. Australia 26,042, April 4, 1930. Glass is etched by sandblast or chemical action and covered with a frit which is fused to change the mat to a sateen finish. (*C.A.*)

Glass. JOSHUA M. WILSKER. Australia 29,080, Sept. 17, 1930. Colorless soda-lime glass is made by incorporating in the glass a chemical agent adapted to oxidize sufficient of the FeO to produce equal proportions of FeO and Fe_2O_3. The agent may be a red sand containing a high proportion of Fe_2O_3. (*C.A.*)

Decorating glass. F. HUBERT. Belg. 384,591, Jan. 30, 1932. Effects imitating marble are produced by dissolving glue in H_2O, projecting into the solution coloring matters dissolved or worked into paste in spirit of turpentine and kerosene, and mixing. (*C.A.*)

Reinforced glass decorative elements. E. GEILLE. Belg. 385,171, Jan. 30, 1932. A sheet of glass, having one face suitably decorated, is applied to a backing sheet of fibro-cement, cardboard, glass, etc., by means of a mortar consisting of equal parts of Na and K silicate, together with powdered pumice stone and metal oxides. (*C.A.*)

Glass. I. G. FARBENINDUSTRIE A.-G. Fr. 719,067, June 24, 1931. Devitrification of glass having a high content of TiO_2 is avoided by rapidly cooling the fused mass. (*C.A.*)

Glass. I. G. FARBENINDUSTRIE A.-G. Fr. 724,367, Sept. 17, 1931. Fused $AlPO_4$ is used as vitrifying agent in making glass containing basic oxides. See preceding abstract. (*C.A.*)

Safety glass. I. G. FARBENINDUSTRIE A.-G. Fr. 724,002, May 7, 1931. The intermediate layer between the sheets of glass is made of products obtained by mixed polymerization of mixtures of 2 or more polymerizable substances which do not become brittle even at very low temperatures. The mixed polymerization products obtained from acrylic acid, its derivatives, and homologs of these compounds alone or mixed with

resins, *e.g.*, resins prepared by condensing CH_2O with toluenesulfamide, are particularly suitable for making safety glass resistant to cold. (*C.A.*)

Reinforced glass. CHANCE BROS. & CO., LTD. Fr. 725,073, Oct. 26, 1931. A method of incorporating the metallic reinforcement is described. (*C.A.*)

Decolorizing glass. DEUTSCHE GASGLÜHLICHT-AUER GES. M.B.H. Fr. 725,480, Oct. 30, 1931. Se and tervalent rare earths such as La, Pr, and Nd are used in addition to Ce for decolorizing glass. (*C.A.*)

Glass. BERNHARD ENGELS. Fr. 725,862, Nov. 6, 1931. Apparatus for making plane sheets of glass by drawing from the surface of molten glass is described. (*C.A.*)

Apparatus for making glass wool. NAAMLOOZE VENNOOTSCHAP MIJ. TOT BEHEER EN EXPLOITATIE VAN OCTROOIEN. Fr. 726,355, Nov. 18, 1931; see also *Ceram. Abs.*, 11 [11], 560 (1932). (*C.A.*)

Composite glass. SOC. ANON. DES MANUFACTURES DES GLACES ET PRODUITS CHIMIQUES DE ST.-GOBAIN, CHAUNY, ET CIREY. Fr. 726,865, Jan. 27, 1931. Several layers of glass are united to one another with heating, the middle layers having a coefficient of expansion higher than the outer layers. (*C.A.*)

Glassmaking furnaces. JULIUS SCHÜFFLER. Fr. 727,020, Nov. 28, 1931. (*C.A.*)

Safety glass. SOC. DES USINES CHIMIQUES RHÔNE-POULENC. Fr. 727,055, Jan. 30, 1931. The interposed sheet of plastic material is submitted for several hours to the action of a vacuum to free it from occluded gases or vapors. (*C.A.*)

Apparatus for making plate glass. NAAMLOOZE VENNOOTSCHAP MIJ. TOT BEHEER EN EXPLOITATIE VAN OCTROOIEN. Fr. 728,077, Dec. 10, 1931. (*C.A.*)

Apparatus for making reinforced glass. MISSISSIPPI GLASS CO. Fr. 729,175, Dec. 31, 1931. (*C.A.*)

Centrifugal device for continuously purifying molten glass. AUGUSTE FOURLINNIE. Ger. 549,674, Nov. 29, 1930. (*C.A.*)

Device for drawing tubes from fused quartz. QUARTZ & SILICE SOC. ANON. Ger. 549,676, March 10, 1931. (*C.A.*)

Annealing oven for glass. UNITED GLASS BOTTLE MANUFACTURERS, LTD. Ger. 549,996, Aug. 7, 1929. (*C.A.*)

Glass. DEUTSCHE SPIEGELGLAS A.-G. Ger. 550,782, May 6, 1927. Glass for protecting the eyes, with a strong absorptive power for ultra-violet and ultra-red rays, is made by adding not less than 0.3% of CoO and FeO or 0.5% As_2O_3 and Sb_2O_3 to the glass in its fused condition. (*C.A.*)

Tunnel kiln for cooling glassware. AMSLER-MORTON CO. Ger. 550,834, March 30, 1928. (*C.A.*)

Tunnel kiln for cooling glassware. WM. A. MORTON. Ger. 552,898, April 17, 1929. (*C.A.*)

Device for drawing glass rods and tubes. GEORG GEHLHOFF (Patent-Treuhand-Ges. für elektrische Glühlampen m.b.H.). Ger. 553,742, Dec. 13, 1929. (*C.A.*)

Wired glass. BAUINDUSTRIE A.-G. "BIAG." Ger. 554,025, April 5, 1931. Methods of arranging the wire in the glass are described. (*C.A.*)

Continuous apparatus for making glass tubes, etc. OTTO MAETZ, HÜTTENTECHNISCHES BÜRO AND GLASFABRIK WERNERHÜTTE INHABER GEBR. SCHULLER. Ger. 554,026, June 16, 1931. (*C.A.*)

Device for drawing glass rods or tubes. NAAMLOOZE VENNOOTSCHAP MIJ. EXPLOITATIE UITVINDINGEN. Ger. 554,728, June 12, 1931. (*C.A.*)

Pot for melting glass. DEUTSCHE SPIEGELGLAS A.-G. Ger. 555,062, Feb. 18, 1931. (*C.A.*)

Form for preparing nonshattering glass. S. S. GROMOV. Russ. 17,638, Sept. 30, 1930, and 25,689, March 31, 1932. Construction details are given. (*C.A.*)

Fancy unbreakable glass. S. S. GROMOV. Russ. 25,690, March 31, 1932. In the preparation of fancy glassware solidification of the plastic mass holding the glass together is effected by introducing through a tube into the space filled with the plastic mass a reagent to effect the coagulation. (*C.A.*)

Apparatus for compressing a number of curved glass layers. S. S. GROMOV. Russ. 25,691, March 31, 1932. Construction details are given. (*C.A.*)

Preventing blurring of glass. S. S. GROMOV. Russ. 25,692, March 31, 1932. Blurring of glass is prevented by applying to its surface a solution of glue in warm H_2O and pure alcohol with the addition of small quantities of water glass, drying, and treating with alcoholic solution of formalin. (*C.A.*)

Apparatus for drawing tubes or rods from molten glass. S. I. KOROLEV AND P. B. BROMLEV. Russ. 26,028, April 30, 1932. Construction details are given. (*C.A.*)

Laminated glass. N. I. VOLUINKIN. Russ. 61,279, Dec. 28, 1929. Glass plates are held together by a condensation product of phthalic anhydride and glycerol which is placed in powder form on the heated glass surface. (*C.A.*)

Nonshattering glass. N. I. VOLUINKIN. Russ. 26,029, April 30, 1932. Glass layers are held together by means of a solution of a condensation product of urea and aldehyde in alcohol. The alcohol is removed before pressing by drying at a temperature of about 102°. See preceding patent. (*C.A.*)

Machine for polishing cylindrical glass goods. N. G. VERDNIKOV AND I. V. VERDNIKOV. Russ. 26,212, April 30, 1932. (*C.A.*)

Apparatus for measuring the velocity of the flow of glass in a glass furnace. V. E. BROMLEY. Russ. 26,410, Jan. 30, 1931. (*C.A.*)

Structural Clay Products

Compressive strength of steel columns incased in brick walls. ALBERT L. HARRIS, A. S. STAND, AND J. W. MCBURNEY. Bur. Stand. *Jour. Research*, **10** [1], 123–38 (1933).—Three H-shaped steel columns, 23 ft. long, 6 in. in depth, weighing 20 lb. per foot, and having flat ends, were tested in compression. Six similar columns incased in brick walls 14 in. thick, 6 ft. long, and extending up to about 8 in. from the top of the steel columns were also tested in compression. Results were as follows: (1) The brick walls effectively prevented lateral buckling of the steel column so that the maximum compressive load for the structure was, for all practical purposes, the maximum compressive load for the portion of the steel column above the wall, which in turn was, for all practical purposes, the tensile yield point of the steel multiplied by the cross-sectional area by steel column. (2) The maximum compressive load carried by the short unincased portion of the steel columns was much greater than the maximum compressive load carried by the long unincased columns which failed by lateral buckling. (3) The lateral deflection of the incased columns was negligible. The brick masonry showed only small cracks at the top near the steel columns. (4) Over the gage length of 150 in. at mid-height of the incased columns, the steel carried, on the average, less than 20% of the applied load. (5) The orientation of the steel column with respect to the face of the brick wall had no effect upon the strength of the incased columns. R.A.H.

Contributions to the study of fluorescences. B. BUTTERWORTH. *Brit. Clayworker*, **41** [488], 296–303 (1932).—On the basis of a general discussion of the problem of fluorescence the requirements of a test which shall show the liability of brick to this defect are set down. The essentials of such a test are that water should be supplied to the brick and allowed to evaporate from its surface. The material taken into solution will then appear as a deposit on its surface. Two methods used at the Building Research Station are as follows: In one case the brick is placed upright in a dish of distilled water, the wetting of the brick taking place by capillary rise in the pores. In the other, a flask of water is inverted on the upper end of the brick and the water gradually seeps through the brick. The nature of the information provided by the tests is considered with reference to photographs of the results obtained in a number of cases. A summary of the microchemical methods which have been found most useful in establishing chemical identity of fluorescence is given. The extent to which the interpretation of the test results is possible in the light of present knowledge is briefly outlined. R.A.H.

Is efflorescence in brick masonry injurious? ANON. *Tonind.-Ztg.*, **56** [93], 1144 (1932).—Efflorescence is mainly observed in the autumn and spring. Not only the amount of soluble salts present in the clay will determine the appearance of efflorescence, but also the structure of the products, the number of pores, their form, etc. It is not decided yet whether or not efflorescence will do any harm to the masonry. W.M.C.

Testing of brick. H. NITZSCHE. *Tonind.-Ztg.*, **56** [82], 1020 (1932).—This is a discussion of a paper by Hirsch (*Ceram. Abs.*, **11** [8], 455 (1932)) and a reply by Hirsch. See following abstract. W.M.C.

Recent German scientific research applied to the brick industry. H. HIRSCH. *Tonind.-Ztg.*, **54** [84], 1330–32 (1930).—Scientific researches which may be applied to the brick industry cover the fundamental properties of the raw materials and the fired products. A large number of testing methods has been developed in recent years. Apparent and true porosity must be determined from which may be calculated the ratio of the open and closed pores. The form of pores and the size of the capillaries can be determined by measuring the permeability for water and air. The strength of brick is tested by sawing small pieces out of the full-sized brick or by special test brick of small

dimensions. The bending strength is found after cementing two brick halves together. A special arrangement is shown to determine the bending strength of flat products which are supported by a number of steel rods arranged according to the shape of the sample. The freezing behavior of brick and tile is determined by alternately freezing the products 25 times and heating them to room temperature. The cooling and reheating should not be done too rapidly. Illustrated. W.M.C.

Czechoslovakian standards for full brick. ANON. *Stavivo*, p. 27 (1932).—Standards published by the State Dept. of Labor in 1931 are as follows: (A) clinker or "stoneware brick," porosity 7.5% mean value, 9% maximum value, crushing strength at least 600 kg./sq. cm.; (B) hard-fired brick, porosity 15% mean value, 18% single value, crushing strength at least 300 kg./sq. cm.; (C) medium-fired brick, porosity 15% or more, crushing strength at least 150 kg./sq. cm.; (D) common brick, porosity 15% or more, crushing strength at least 75 kg./sq. cm. Of the dimensions, only thickness is specified with 6.5 cm. The Building Department Orders remain in force in regard to the other dimensions, *i.e.*, 29 x 14 cm. For the determination of crushing strength, cubes of 5 cm. are cut from the middle and exterior parts of the brick. For porosity determinations, the samples are soaked with boiling water for 1 hour. Resistance against frost is tested by freezing the brick soaked with water at a temperature of 10 to 15°C, thawing them under water at 15 to 20°C, and repeating this procedure 25 times. R.B.

Significance of standards for fully fired brick. ZDENĚK ŠÍMA. *Stavivo*, p. 328 (1931); see following abstract. R.B.

Significance of standards for fully fired brick. JOSEF MATĚJKA. *Stavivo*, p. 328 (1932).—Czechoslovakian standards do not specify the dimensions of brick but only the thickness with a tolerance of −5%. The other dimensions in most cases are 29 x 14 or 25 x 12 cm. and tolerances of −3% in length and −4% in breadth are allowed. R.B.

Hollow and lightweight tile and their use in modern architecture. O. KALLAUNER. *Stavivo*, p. 171 (1932).—The following hollow brick are described: the South Bohemian Petraš brick which resembles the No-Fo-T brick and has the shape of a T (see *Ceram. Abs.*, **11** [1], 31 (1932)), the brick of Ambrož, Prášil, Brabec, and others. A survey of hollow brick from foreign countries is given. 14 illustrations. R.B.

The Brabec hollow brick. JOSEF MAREK. *Stavivo*, p. 176 (1932).—This hollow tile is closed on 5 sides and is produced by pressing. About 1500 brick may be pressed hourly. The tile has 8 or 21 hollows. R.B.

Hollow brick closed on five sides. JOSEF PRÁŠIL. *Stavivo*, p. 170 (1932).—Cubes cut from clay are placed in molds and pressed into double brick. The weight of the hollow brick is about ¾ kg. lower than common full brick. 2 illustrations. See also abstract entitled "Westmold face brick," *Ceram. Abs.*, **11** [5], 306 (1932). R.B.

Lightweight brick. A. CHMELÍČEK. *Stavivo*, p. 347 (1932).—The weight of 29 x 14 x 6.5 cm. brick may be as low as 1.5 kg., although it is 3 kg. in most cases compared with 4.5 kg. for full brick. If the inflammation temperature of the combustible substance used is lower, firing will be easier. R.B.

Raw materials for brick and tile. I. ALIX CORNILLE. *Rev. mat. constr. trav. pub.*, No. 278, pp. 206–208 *B* (1932).—C. discusses the characteristics of raw materials used in the production of brick and tile in France. M.V.K.

Use of handmade brick for structural purposes. JOSEF MATĚJKA. *Stavivo*, p. 260 (1932).—The Czechoslovakian standard specifications make no difference between handmade and machinemade brick; decisions can be made only by comparing the properties of both. R.B.

Power and heat in brick plants. W. LEDER. *Tonind.-Ztg.*, **56** [95], 1168–70 (1932).—Different types of power and heat supply in brick plants and the possibilities of keeping the costs down are reviewed. The use of waste heat is emphasized. W.M.C.

Results of comparative tests on clay sewer pipe. O. KALLAUNER. *Stavivo*, p. 479 (1931).—K. conducted a series of tests on clay sewer pipe according to Czechoslovakian, German, and Austrian standards. All Czechoslovakian products corresponded to the Czechoslovakian and German specifications but some of the German and Austrian clay sewer pipe did not meet Czechoslovakian specifications for structure or porosity. None of the pipes tested, not even the pipes of Austrian manufacture, met the severe Austrian specifications. The limit of 4.5% for porosity specified by the Austrian standards was too high for stoneware pipe of Czechoslovakian and German as well as Austrian manufacture. R.B.

Porous building material and artificial stone. LADISLAV VODIČKA. *Stavivo*, p. 228 (1932).—Porous bodies may be produced by adding substances which form froth to

cement or gypsum. A good froth is obtained from mixtures of resin soaps, glue, caseinates, or other gel-forming substances with water or from sulfite lye. Other light construction materials are produced by the addition of light substances, *i.e.*, cork, diatomaceous earth, etc. R.B.

All clay products house. C. J. GAGNON. *Clay-Worker*, **98** [6], 226–27 (1932).—A detailed description of the brick and clay tile house built by Jacob Hockers, Green Bay, Wis., at a cost of not more than frame construction is given. Illustrated. E.J.V.

Unusual brick house designed for Century of Progress. ANON. *Brick Clay Rec.*, **81** [6], 196–97 (1932).—Illustrated. E.J.V.

Brick pavement. ANON. *Tonind.-Ztg.*, **56** [93], 1149 (1932).—The use of common brick which are soaked with tar is emphasized. W.M.C.

Brick buildings. A. HOFHERR. *Tonind.-Ztg.*, **56** [93], 1146–47 (1932). W.M.C.

Reinforced brick masonry; the forgotten opportunity. HUGO FILIPPI. *Clay-Worker*, **98** [6], 224–27 (1932).—F. points out that reinforced brick masonry is here to stay, and fails to see how its advantages could have been overlooked when it was first developed by Brumel. The many advantages of this type of construction are discussed. Illustrated. E.J.V.

Menace of prison-operated plants to clay products industry. GEORGE S. EATON. *Brick Clay Rec.*, **81** [6], 206 (1932).—This is a major portion of a report made to the Shannon Committee investigating government competition to private enterprise. E.J.V.

PATENTS

Manufacture of light porous materials. E. RODGERS, JR., AND G. D. DUNCAN, JR. U. S. 1,842,801, Jan. 26, 1932.

Building block and the construction of floors, etc. K. E. W. JAGDMANN. U. S. 1,891,597, Dec. 20, 1932.

Feeder for argillaceous materials. W. B. PINE. U. S. 1,892,583, Dec. 27, 1932. In an apparatus for producing articles of argillaceous materials heated to a plastic or semiplastic but not completely fused condition, in combination with means for forming the materials, means for advancing the materials to the forming means in their heated and plastic or semiplastic but not completely fused condition, including a feeding device having walls forming a passage decreasing in cross-section toward the bottom of the device and leaving a discharge opening at its bottom, the passage being of sufficient height that the plastic materials pack together toward the bottom thereof, means for heating the materials in the passage, and means whereby air and gas in the mass escape from the passage.

Coating of tile, slabs, brick, etc., with sand, etc. E. HODGKINSON. Brit. 384,228, Dec. 7, 1932.

Automatic cutting machines for brickyards. J. C. A. M. DE BIE. Brit. 384,589, Dec. 14, 1932.

Refractories

Introducing binary kaolins into the fireclay mix in order to increase its alumina content and refractoriness. P. P. BUDNIKOFF AND V. I. ENDOVITZKII. *Domez*, No. 1–2, pp. 11–13 (1932); for abstract see *Ceram. Abs.*, **11** [12], 616 (1932). (*C.A.*)

Further details on Siemensit. H. HIRSCH. *Tonind.-Ztg.*, **56** [93], 1147–49 (1932).—New tests with this material cover the following properties: structure, elasticity, thermal conductivity, refractoriness, load test during firing, change of volume, thermal shock resistance, attack by glasses and slags, and microscopic investigations. The results were satisfactory. See following abstract. W.M.C.

High-grade refractory material (Siemensit). J. SCHMAUSER. *Tonind.-Ztg.*, **56** [91], 1123–24 (1932).—"Siemensit" was obtained by increasing the chromic oxide, alumina, and magnesia of the slag, which is a waste product of the manufacture of ferrochromium. The refractivity of the new product reaches cone 42. The tile are cast or formed from fine-grained slag. A number of different sizes of Siemensit tile is shown, together with some photomicrographs. See also abstract by Sittard, *Ceram. Abs.*, **12** [2], 67 (1933). W.M.C.

Siemensit refractories. GERMAN STERLWORKS' ASSN. *Report*, No. 237 (1932); abstracted in *Refrac. Jour.*, **8** [11], 444 (1932).—A detailed account is given of the ap-

plications of Siemensit refractories in open-hearth furnaces in connection with short port blocks. Details are given of the properties of these refractories which show that they are highly resistant to acid and basic slag corrosion effects at high temperatures. In one experiment the furnace life covered the production of 102,000 tons of steel when Siemensit refractories had been used in the furnace construction. This type of refractory has found considerable application in German steelworks practice. E.P.R.

Magnesite refractories for lime works. ANON. *Stavivo*, p. 431 (1932).—The use of magnesite linings can not be recommended as the mechanical strength of magnesite refractories is too low and they may melt in contact with other refractories used. R.B.

Sintering of cement-clinker brick. W. N. JUNG. *Zement*, **21** [30], 433–38 (1932).—(1) The character of the changes occurring in cement-clinker brick for the lining of the sintering zone of revolving furnaces is described and the reasons for the low resistance are determined. (2) Experiments for changing these brick into a sintered clinker mass to obtain a resistant lining are discussed. (3) The testing of the resistance to changes of temperature of vitrified clinker brick (under conditions similar to those occurring in revolving furnaces) showed that they are from 9 to 14 times more resistant than ordinary unfired cement-clinker brick. M.V.K.

Heat-resisting cement and concrete. COLIN PRESSWOOD. *Fuel Econ.*, **7** [80], 340–41 (1932).—The fact that the joints are often the weakest part of a refractory wall led to the manufacture of the so-called "hard" or "cold-setting" cements. These hard-setting cements do not require high temperatures and incipient fusion if they are to unite brick to brick and their "set" imparts mechanical strength to the joints. Refractory concrete aggregate should be crushed from selected old fire brick in such a way as to produce grains of assorted sizes and as angular as possible. Aggregate is best soaked in water and, after straining, mixed with dry cement, the final tempering being done after mixing. M.V.K.

High-temperature heat insulation. A correlation of existing data. M. L. NATHAN. *Trans. Inst. Chem. Eng.*, **9**, 177–90 (1931).—Unless pore spaces are large, heat is transmitted through insulators mainly by conduction. The increase in conductivity with temperature is mainly due to the increased conductivity of air. The effect of surface resistance on losses from an insulated body is slight, as also is that of external air velocity. Surface temperature is not a measure of heat transfer; methods of determining heat transfer are described. The insulating efficiency of diatomite is reduced by firing to brick with sawdust and clay, but the strength is increased. Slag wool can not be used at above 700°, and the air spaces are > with diatomite. Fire brick are now made which incorporate powdered Al, Ca, or other material which develops gas when mixed with H_2O and gives the required porosity. Crumpled sheets of Al foil are also used at lower temperatures. At high temperatures insulating brick are better than tamped diatomite powder. Impure diatomite is less resistant to high-temperature effects. High-temperature insulating materials are tested for conductivity by the hot-plate and guard-ring method. Economic thicknesses of insulation can be calculated. (*B.C.A.*)

Protective coatings for refractories. B. HELAN. *Stavivo*, p. 226 (1932).—The following protective coatings are described: (1) "Resistin," a product of the Union for Chemical and Metallurgical Production, which is especially useful for glasshouse kilns, (2) "Pyrocement," a repairing mass produced by Platinon, Ltd., and (3) "Pyrolit," a product of the same manufacturers, used as coating and as plastic ramming cement. R.B.

Refractories: an outline of the industry. FRANK S. RUSSELL. *Refrac. Jour.*, **8** [11], 421 (1932).—R. classifies refractories and describes methods of manufacture. Electrically fused magnesia made into brick results in a product low in iron and impurities. The basic brick of the future will either be the purer magnesite brick or one manufactured from an alumina-chrome-magnesite spinel. E.P.R.

Thermal dissociation of limestone, dolomite, and magnesite. S. V. POTAPENKO. *Zhur. Prikladnoi Khim.*, **5** [6–7], 693–704 (1932). M.V.K.

Silico-aluminous materials for lime kilns. P. LEONE. *Ann. chim. applicata*, **22**, 397–404 (1932).—Poor resistance of CaO-kiln refractories is considered in relation to the ternary system, CaO–Al_2O_3–SiO_2 (cf. *Brit. Chem. Abs.*, ii, 50 (1915)). Proportions of Al_2O_3:SiO_2 which lead readily to a low-melting eutectic with CaO should be avoided. The refractory should be compact and uniform, without cracks, etc., which facilitate attack by CaO. (*B.C.A.*)

Influence of titanium oxide on the sintering of magnetic sand in Japan. TAKESHI KATO. *Suiyokwai-Shi*, **6**, 837–44 (1932).—Several kinds of magnetic sand were briquetted and sintered at various temperatures. The crushing strength and porosity were

determined. Sintering required temperatures above 1250°. The higher the content of TiO_2, the higher the sintering temperature. The magnetite containing 4.5% SiO_2 and without TiO_2 sintered well at 1100° and melted at 1150°, but the sand containing 4.5% SiO_2 and 15.12% TiO_2 sintered slightly at 1250° and did not melt even at 1300°. (*C.A.*)

Use of glazed sagger grog. LADISLAUS SZABÓ. *Ber. deut. keram. Ges.*, **13** [9], 427–32 (1932).—In the plant where S. is located, glazed grog has been used with unglazed and neither in relation to stability nor to resistance to temperature change has any detrimental effect been observed, although breaking data were accurately taken for periods of 2 to 3 months. E.J.V.

Dimensions of products made from refractory clays. JINDRICH ROSENBAUM. Abstracted from *Stavivo*, p. 265 (1931); *Rev. mat. constr. trav. pub.*, No. 272, p. 92*B* (1932).—The differences in sizes of products made from the same mass depend mainly on the degree of humidity of the mix. This humidity is not the same in the whole mix. The methods of molding, pressing, cutting, etc., have their effect, as do also the methods of firing and drying. Generally, the dimensions of basic products are more easily maintained, while the sizes of products with a high silica content are more difficult to preserve. M.V.K.

Manufacture of refractory brick. G. P. REINTJES. *Petroleum Engr.*, **3** [6], 58 (1932).—The mining of Mo. and Colo. clays and the manufacture of refractory brick from them are discussed. Abrasion, spalling, slagging, and deformation of refractories are caused by (1) CO_2, (2) FeO, (3) S, (4) impingement of flame, (5) too rapid heating or cooling, (6) too rapid or too slow heat transfer, (7) confined expansion, and (8) excessive loads. Temperature alone seldom causes furnace-wall failures. (*C.A.*)

Plant for making silica brick. ANON. *Crushing & Grinding*, **1**, 137–39 (1932).—The plant of the Meltham Silica Brick Co. is described. (*C.A.*)

Silica lining for firing large-sized silica brick. G. BERGAU. *Tonind.-Ztg.*, **56** [97], 1196–97 (1932).—A furnace is described which contains two chambers lined with silica brick. Large joints provide for the expansion of the brick during heating. The advantages claimed are long life of the lining, fuel economy, and high output. W.M.C.

Constitution and thermal expansion of silica coke-oven brick after service. J. B. AUSTIN AND R. H. H. PIERCE, JR. *Jour. Amer. Ceram. Soc.*, **16** [2], 102–106 (1933).

Chromite-Dinas brick. P. P. BUDNIKOFF AND E. L. MANDELGRÜN. *Zhur. Prikladnoi Khim.*, **5** [3–4], 299–302 (1932).—As Dinas is thermally unstable and has a poor resistance to alkaline slag, 20, 30, and 50% chromite were added to the Dinas mix to obtain a refractory stable to the thermal and chemical action of acid and alkaline slag. Chromite from the Urals containing 29.13% Cr_2O_3 and 32.68% Fe_2O_3 and Ukrainian amorphous quartzite with a 96.92% SiO_2 content were used. The brick was shaped pneumatically and fired in a tunnel furnace. The brick obtained had a lowered refractoriness (Seger cones 28 and 29) and deformation appeared between 1335 and 1435°. The microscopical investigation of the structure showed a thorough transformation of quartz into tridymite and cristobalite. The investigation of the thin section of the mixture of Cr_2O_3 and SiO_2 after heating it to 2100° for 1 hr. showed the presence of undissolved Cr_2O_3 in a finely distributed state in a net composed of tridymite crystals, cristobalite, and the amorphous mass. Undoubtedly, Cr_2O_3 and SiO_2 do not combine in chromite-Dinas brick. M.V.K.

Silicates high in alumina. VLADIMIR SKOLA. Abstracted from *Chem. Listy*, **25**, No. 2–3 (1931); *Glastech. Ber.*, **10** [4], 241 (1932).—S. discusses the researches of a series of investigators dealing with sillimanite and mullite. The use of natural and artificial raw materials and different ways of working them are described in detail. The necessity and importance of systematic investigations in the field of silicate industry are pointed out. See also *Ceram. Abs.*, **11** [2], 111 (1932). M.V.K.

Manufacture of silicon carbide and artificial corundum. A. C. *Rev. mat. constr. trav. pub.*, No. 277, pp. 425–26 (1932).—Silicon carbide is produced from coal (coke) and siliceous sand treated in an electric furnace. At 1400° an amorphous material is obtained which has no refractory qualities, being too sensitive to oxidation. To secure a refractory product the mixture is heated up to 1800 and 2200° to obtain crystallization; over this temperature silicon carbide is no longer stable and decomposes into its elements. The reaction is facilitated by adding sea salt and sawdust. Corundum exists in nature and has 95 to 98% pure alumina, although the emery from Naxos contains only 55 to 60% alumina. Some bauxites are easily transformed into crystallized alumina in an electric furnace at about 2000° and an artificial corundum is thus obtained. Because of crystallization, corundum easily separates from impurities. There is a great difference between crystallized corundum obtained in such a way and bauxite which has

simply been fused, because the latter has none of the qualities of stability produced by crystallization. M.V.K.

Graphite as a refractory. RICHARD H. STONE. *Jour. Amer. Ceram. Soc.*, **16** [2], 96–101 (1933).

Significance of permeability to gases in relation to the use of refractory materials in gas retorts. F. H. CLEWS AND A. T. GREEN. Twenty-Third Report of the Refractory Materials Joint Sub-Committee. *Gas Jour. Supp.*, **200** [3623], 22–23 (1932); abstracted in *Power Fuel Bull.*, **23**, 182 (1932). W.E.R.

Action of waste wood and oil fuel on refractories. KENNETH G. SKINNER AND NORMAN L. FIELD. *Brick Clay Rec.*, **81** [6], 204 (1932).—Results obtained show that the degree of slagging of a brick in a furnace using a combination of these fuels is dependent upon the following factors: (1) combination of waste wood and fuel oil, (2) design of the furnace, (3) operation of the furnace, (4) differences in the composition of the brick, (5) porosity and structure of the brick, (6) texture of the brick, crystalline or amorphous, and (7) differences in chemical composition of various ashes. Illustrated. E.J.V.

Coreless induction furnaces. R. N. BLAKESLEE, JR. *Foundry*, **60** [9], 18–46 (1932).—Acid and basic linings and crucibles used in metal melting in coreless induction furnaces are discussed. Illustrated. F.G.H.

Stud tubes solve furnace problems with slagging coal. ANON. *Power*, **75** [14], 500–503 (1932).—Experimentation in plants using low-grade coals containing much ash, sulfur, and pyrites has led to the development of slag screens in which tubes are studded with pins and coated with plastic refractory. These screens greatly reduce the slagging of the main boiler tubes. Stud-tube furnace walls have also proved successful. Details of construction of screens and walls are described and illustrated. F.G.H.

Causes and control of slag formation. J. L. CORCORAN. *Power*, **75** [18], 651–54 (1932).—C. discusses (1) the theory of slag formation in the combustion of coal, (2) the melting points of ash as determined by its constituents, and (3) slagging in stoker and pulverized-coal furnaces and some methods of coping with the problem. F.G.H.

Observations on the behavior of refractory materials in continuous vertical retorts. A. T. GREEN. *Brit. Clayworker*, **41** [487], 276–82 (1932).—Data are given showing the deleterious influences affecting the life of refractories in continuous vertical retorts. The zonal nature of certain troubles is indicated. R.A.H.

Mullite tank blocks. ANON. *Tonind.-Ztg.*, **56** [98], 1208 (1932).—A review is given of the papers by F. W. Schroeder (*Ceram. Abs.*, **10** [7], 504 (1931)) and Hirsch (*ibid.*, **9** [9], 743; [10], 852 (1930)). W.M.C.

Suspended combustion chamber walls. ANON. *Metallurgia*, **7** [37], 27–28 (1932); see also *Ceram. Abs.*, **12** [2], 66 (1933). M.V.K.

Destruction of blast-furnace linings. F. HARTMANN. *Stahl & Eisen*, **52** [44], 1061–66 (1932).—Eight types of destruction were observed including abrasion, cracking by sudden temperature changes, sintering, melting, slag attack, explosive action of carbon and zinc, and influence of fluorite. The occurrence and form of attack is described in detail with special regard to cracking caused by sintering. Photomicrographs show the different types of destruction. Experiments proved that the destructions by carbon and zinc are independent of each other. An extension of the German standard specifications for refractory materials is emphasized. W.M.C.

Interlocking corbel tile for supporting furnace linings. PLIBRICO JOINTLESS FIREBRICK CO. *Power*, **75** [2], 76 (1932).—A new type of interlocking corbel tile designed especially for use in connection with monolithic furnace linings is described and illustrated. F.G.H.

Refractories for tank furnaces. J. B. MURGATROYD. *Pottery Gaz.*, **58** [667], 79 (1933).—M. explains the method of manufacturing Corhart blocks. A brief description of the properties of the blocks and of experience with this type of refractory is given. E.J.V.

Tank blocks and their manufacture. A. JAESCHKE. *Glashütte*, **61**, 330, 435, 472, 491, 508, 522, 540, 559, 703, 718 (1931). (*J.S.G.T.*)

Boiler operation at high rating with minimum refractory repair. H. S. PRICE. *Power*, **75** [3], 107–108 (1932). F.G.H.

Steel founding in America. F. A. MELMOTH. *Foundry*, **60** [8], 16–49 (1932).—Basic and acid refractories for open-hearth and electric furnaces are discussed. Illustrated. F.G.H.

Melting costs for various furnaces. H. E. WHITE. *Foundry*, **60** [10], 44–45 (1932).—Costs of various refractories are considered in computing unit melting costs. F.G.H.

Properties of refractory materials. ANON. *Eng. Boiler House Rev.*, **46** [5], 297–98 (1932); abstracted in *Power Fuel Bull.*, **23**, 180 (1932).—Material can be provided to resist temperatures higher than are usually found in modern furnaces. Modern refractory material will keep its shape at temperatures as high as 3500°F, whereas the average temperature in the furnace is not often higher than 2400°F, although local hot spots sometimes occur. The properties required and the constituents of refractories are discussed. W.E.R.

Refractory linings for modern blast furnaces. M. BARRETT. *Chem. & Ind.*, **51** [48], 972–73 (1932).—Typical analyses of American, German, and English blast-furnace linings are shown. The present trend is toward the use of a relatively high aluminous material. G.R.S.

Modernizing the steel mill. ANON. *Mech. Eng.*, **54** [1], 35–40 (1932).—Pyrometric control of regenerator firebrick checkerwork makes possible the reversal of gas valves when the brickwork is at the right temperature, which means when it has cooled to the desired extent. The result is that a more uniform operation of the furnace and economy in the consumption of fuel are obtained. F.G.H.

Refractory problems of furnaces fired by pulverized fuel. ANON. *Refrac. Jour.*, **8** [12], 478–79 (1932). E.P.R.

Improvement of the heat exchange in recuperative air preheaters. HARRAEUS. *Feuerungstechnik*, **20** [9], 133–35 (1932); see also *Ceram. Abs.*, **12** [2], 75 (1933). M.V.K.

Occurrence of chromite and magnesite in Aktjubinbezirk. D. G. UL'YAIOV. *Mineral. Suir'e*, **5**, 1013–20 (1930); *Chem. Zentr.*, **I**, 2032 (1931). (*C.A.*)

Bauxite industry. VICTOR CHARRIN. *Rev. mat. constr. trav. pub.*, No. 278, pp. 208–209*B* (1932).—The depression of the French bauxite industry is discussed. M.V.K.

World production of bauxite. V. CHARRIN. *Ind. chimique*, **19**, 85 (1932).—The location of the various deposits is given, together with details of production, home consumption, exports, etc. (*Trans. Ceram. Soc.* [Eng.])

Refractory raw materials of East Moravia. K. ZAPLETAL. *Zprávy Československ. keram. společnosti*, **8**, 128 (1931); abstracted in *Rev. mat. constr. trav. pub.*, No. 272, p. 91*B* (1932).—Refractory materials and their origin are described. M.V.K.

Twenty-Third Report of the Refractory Materials Joint Sub-Committee. ANON. *Gas Jour.*, **200** [3625], 439–41 (1932). G.R.S.

Permeability of refractory materials to gases. IV. Experiments at temperatures up to 850°C. F. H. CLEWS AND A. T. GREEN. Twenty-Third Report of the Refractory Materials Joint Sub-Committee. *Gas Jour. Supp.*, **200** [3623], 22 (1932); abstracted in *Power Fuel Bull.*, **23**, 182 (1932); see *Ceram. Abs.*, **12** [2], 63 (1933). W.E.R.

Dry pressing in the grog industry. I. I. KUZMENKO. Abstracted from *Ukrainsky Silikaty*, No. 4–5, pp. 84–106 (1932); *Feuerfest*, **8** [9], 140 (1932).—A compilation of literature on the subject is given. M.V.K.

BULLETINS

Service properties of fire brick. ANON. *Refrac. Bull.*, No. 10 (Oct., 1932); *Chem. Trade Jour.*, **91** [2372], 425 (1932); *Metal Ind.* [London], **41** [19], 454 (1932).—Thermal expansion data for a fire brick are important because (1) they show what clearances are necessary in furnace structures, and (2) they are a reliable index of the mineralogical constitution of the refractory. The results of tests carried on up to 1400°C divide fire brick broadly into three groups: (1) lightly fired products showing rapid and great contraction at about 1000°; (2) moderately hard-fired products showing a decreased rate of expansion occurring either gradually or abruptly above 1100° due to residual contraction; and (3) hard- to extra hard-fired products showing a practically uniform rate of expansion up to 1400°C. At about 800° fire brick begin to lose their elastic properties and accommodate themselves plastically to deformation. The value of the coefficient of expansion up to 800° is therefore important since it is intimately connected with the spalling resistance. The expansion test is a method of detecting the presence of free silica, either in the form of quartz or the high-temperature modifications, cristobalite or tridymite. In lightly fired brick the free silica is present as quartz and this is shown in the sudden increase in the expansion curve at 530°. In moderately hard-fired brick the free silica is converted and the resulting cristobalite and tridymite show themselves in the low-temperature expansion range. These changes can be seen in the expansion curves of highly siliceous materials. Such materials show an irregular or high expansion up to 800°, and a low and uniform expansion above this temperature. M.V.K.

Influence of furnace design and construction on the life of refractories. ANON. Abstracted from *Refrac. Bull.*, No. 11 (Nov., 1932); *Chem. Trade Jour.*, **91** [2377], 554 (1932).—There are 3 principal factors governing the life of refractories: (1) design of the furnace, (2) operating conditions, and (3) type of refractory used. The maximum economic service of a furnace depends upon the same conditions. The design greatly influences the efficiency of a furnace and also determines the intensity of the conditions which are imposed on the refractories. In addition to the furnace design, care in the actual construction of the furnaces is important. From the operational point of view, if a refractory gives erratic service it is necessary to note (1) if the normal temperature has been exceeded by much and for long, (2) if there has been rapid heating or cooling through spalling ranges, (3) if a strongly reducing atmosphere has been carried, (4) if there have been changes in the batch composition leading to excessive corrosion, and (5) if the load on the furnace has been increased. The advantages of high-grade products are also discussed. M.V.K.

Bauxite and aluminum in 1931. C. E. JULIHN. Bur. Mines *Mineral Resources U. S.* 25 pp. 5¢. R.A.H.

PATENTS

Process of producing alumina. A. W. SCHEIDT (Electric Smelting & Aluminum Co.). U. S. 1,891,608, Dec. 20, 1932. (1) The process of treating aluminous siliceous material comprises forming a charge consisting of ground aluminous siliceous material mixed with bauxite, calcium carbonate, and soda ash, sintering the charge, and dissolving the sodium aluminate. (2) The process of treating coal ashes, etc., consisting predominantly of aluminous silicate in variable quantities comprises forming a charge of such material with calcium carbonate and alkali metal carbonate, with the addition of bauxite in molecular proportions to yield a sinter of uniform composition having not less than one molecule of alkali metal aluminate to each molecule of dicalcium silicate, sintering the charge in a suitable furnace, and dissolving the alkali metal aluminate.

Process of producing alumina from waste coal products. A. W. SCHEIDT (Electric Smelting & Aluminum Co.). U. S. 1,891,609, Dec. 20, 1932. (1) The process comprises mixing the powdered coal ash with a finely divided calcium carbonate sludge and soda ash, sintering the mixture, and extracting the resulting sodium aluminate from the sinter. (2) The process comprises forming a furnace charge of the powdered coal ash, calcium carbonate sludge, soda ash, and bauxite in the proportion of one part of the powdered coal ash and bauxite together, one and a half to two parts calcium carbonate, and one-half to one part of soda ash, sintering the mixture, and extracting the sodium aluminate from the sintered material.

Method of molding graphite refractory compositions. A. M. HANAUER (Lava Crucible Co.). U. S. 1,891,979, Dec. 27, 1932.

Hot top for ingot molds. W. H. HAWS (W. W. Hoffman). U. S. 1,892,464, Dec. 27, 1932.

Refractory. P. G. WILLETTS (Hartford-Empire Co.). U. S. 1,893,313, Jan. 3, 1933. A batch mixture for a ceramic bauxitic refractory comprises unmelted bauxitic mineral having the characteristics of Ga. white bauxite, nonplastic kaolin having the characteristics of Ga. Klondike kaolin, and plastic clay having the characteristics of Ga. G^1 clay, all in a state of impalpable fineness, the mixture having a maturing temperature as low as approximately 2850°F.

Means for producing fired ceramic blocks. P. G. WILLETTS (Hartford-Empire Co.). U. S. 1,893,314, Jan. 3, 1933. The means comprises a block of refractory material and means provided on one side of the block for holding a plurality of piles of granular or powdered refractory material.

Treatment of dolomitic stone. C. C. LOOMIS. U. S. 1,894,184, Jan. 10, 1933.

Filler brick for regenerators for industrial furnaces. J. DOUGALL & SONS, LTD., AND W. B. MITCHELL. Brit. 385,151, Dec. 28, 1932.

Silicon brick, etc. I. G. FARBENIND. A.-G. Fr. 724,792, Oct. 20, 1931. Objects containing Si, as such or in the state of an alloy or silicide, are made by molding masses by compression, heating to 1000°, and only effecting the calcination, properly so called, at a temperature above 1000° after the mechanical working. (*C.A.*)

Aluminates. LONZA-WERKE ELEKTROCHEMISCHE FABRIKEN G.M.B.H. Fr. 726,932, Nov. 26, 1931. Alkaline earth aluminates are made by introducing aluminous material such as bauxite into a molten mass of CaC_2 and CaO which is advantageously made in the same furnace. The alloy formed by the impurities (Si, Fe, Ti, etc.) is first poured off followed by the aluminate. (*C.A.*)

Refractory brick. R. P. HEUER. Fr. 727,046; abstracted in *Refrac. Jour.*, **8** [12],

492 (1932).—A high-quality refractory brick is proposed, consisting of calcined magnesia and clay, which contains a salt of chromic acid or sodium acid sulfate as a dispersing agent. E.P.R.

Blast furnaces, lime kilns, etc. TONWERK LAUSEN A.-G. Fr. 727,170, Nov. 6, 1931. Brick construction is described. (*C.A.*)

Refractory brick. G. M. CARRIE, J. W. CRAIG, A. C. HALFERDAHL, AND F. E. LATHE. Fr. 727,522, Nov. 13, 1931; for patent see Can. 323,157, *Ceram. Abs.*, **11** [11], 578 (1932). (*C.A.*)

Refractory materials. CHARLES BRETON. Fr. 728,493, Feb. 25, 1931. Refractory materials resistant to at least 2000° are made from a mixture containing crystolon 743, refractory clay 257, and dextrin 20 parts. (*C.A.*)

Apparatus for making refractory brick. WILHELM STOLZ. Fr. 728,730, Dec. 22, 1931. (*C.A.*)

Alumina. VEREINIGTE ALUMINIUM-WERKE A.-G. Ger. 551,399, June 10, 1928. Finely divided Al_2O_3 is obtained by treating directly with water an Al_2O_3–Al_2S_3 melt obtained as described in Ger. 451,523, *i.e.*, by fusing bauxite, etc., with a reducing agent in an electric furnace in the presence of a metal sulfide. Preferably, the melt is run directly into water. See also *Ceram. Abs.*, **11** [7], 419 (1932). (*C.A.*)

Silica blocks. HERMANN SALMANG AND BENNO WENTZ. Ger. 555,767, May 15, 1930. Silica blocks for building coke ovens, metallurgical and glass furnaces, etc., are formed by molding and firing mixtures of silica masses containing about 20% CaO and Al-free alkali metals, MgO, or Fe_2O_3. (*C.A.*)

Terra Cotta

Glaze adjusting for the plant executive who does not understand chemistry. PAUL E. COX. *Brick Clay Rec.*, **81** [6], 198–200 (1932).—C. presents empirical formulas for five type glazes, the batch weights for each, the maturing temperature, the product on which used, and probable products on which it might be used. The effect of the different ingredients is briefly discussed and a set of rules for changes to compensate for use of different types of materials is given. See also *Ceram. Abs.*, **12** [1], 25 (1933). E.J.V.

Spraying metals on various ware. L. E. KUNKLER. *Ceram. Ind.*, **20** [1], 21 (1933).—The metal being sprayed is fed into an oxyacetylene flame in the form of wire, atomized, and blown onto the surface. W.W.M.

Metal spraying as finish for stone and iron. W. G. RAFFÉ. *Brit. Ind. Finishing*, **2** [13], 16–17 (1931).—R. discusses a finishing process by metallization, known as the Schoop's metallization process. It has been developed principally with lead, the low melting temperature of which lends itself to the pressure-spray principle involved. This spreads an absolutely impermeable surface of lead under high-pressure gas which forces the pulverized metal to form a compact and even surface on the material receiving it. The metal fills up the pores of the brick or stone and secures a strong mechanical adhesion. On metal such as iron there is also a more or less complete chemical attachment as in ordinary tinning or galvanizing. M.V.K.

Firing stoneware in a reducing atmosphere. M. HAUSER. *Tonind.-Ztg.*, **56** [97], 1192–94 (1932).—An oxidizing firing is to be preferred with as small an excess of air as possible. When the salt is being added, however, a reducing atmosphere should be maintained. W.M.C.

Influence of firing temperature on quality of roofing tile. A. MODRÁČEK. *Stavivo*, p. 225 (1932).—Experiments confirm the findings of Josef Matějka (see *Ceram. Abs.*, **10** [10], 735 (1931)) that tile fired at lower temperatures are of better quality. R.B.

Use of fired clay. III. (Pour la terre cuite.) ANON. *Brit. Clayworker*, **41** [487], 259–60 (1932).—Progress in the technique of manufacture of roofing slabs has rendered it possible to make slabs up to a meter in length. The upper side has ribs on which the nibs of the tile can be hung, thereby realizing an important saving in roof framing. The superiority of ceramic tile over similar products in cement is well known, especially from the point of view of facility of maintenance and cleaning after fixing, for cement, which is very porous, indelibly retains all spots which soil its surface. Pipes for chimneys, air ducts, flue pipes, and drain pipes are discussed from the point of ease of installation and permanence. For Part II see *Ceram. Abs.*, **12** [1], 17 (1933). (Parts I and II of this series are incorrectly numbered II and III.) R.A.H.

Manufacture of good roofing tile. JOSEF MATĚJKA. *Stavivo*, p. 372 (1932).—The selection of raw materials, grogging, body preparation, molding, drying, and firing are discussed. The optimum firing temperature lies between 950 and 1050°C. R.B.

Experiences in pressing roofing tile with the hand press "Arfa." VLASTIMIL SIXTA. *Stavivo*, p. 159 (1932).—Moist clay is pressed in the hand press. The clay is smoothed down and pressed by a system of lever arms. On the reverse side of the press an opening is provided for escaping air. About 300,000 tile may be pressed by three men in one season. The press is advantageous for small brickworks for pressing and repressing tile. Illustrated. R.B.

"Kammer" tile as a building unit. ANON. *Tonind.-Ztg.*, **56** [96], 1184–85 (1932).—A large-sized tile with long holes is illustrated. W.M.C.

Results of tests on glazed clay tile. O. KALLAUNER. *Stavivo*, p. 61 (1932).—The important properties of clay tile from different production districts in Czechoslovakia were tested for the purpose of standardization. R.B.

Manufacture of majolica tile in small factories. KAREL THON. *Stavivo*, p. 459 (1931).—Tile manufacture is described in small factories which are provided with the following equipment: 2 ball mills, 2 mixers, 1 small filter press, a series of small ball mills, 1 grinding pan with perforated bottom, a breaker for dry material, 1 friction press for tile, and 2 hand presses for shapes. The kiln has a length of 7.50 m. and a height of 3.00 m. The daily output is 17,000 tile; 32 to 34 workers are employed. The factory is built on an area of not more than 650 sq. m. R.B.

Manufacture of majolica tile. O. KALLAUNER AND K. THON. *Stavivo*, p. 63 (1932).—K. cautions against the establishment of small factories at the present time, and T. recommends their establishment. R.B.

Research on tile stoves in Czechoslovakia. ANON. *Stavivo*, p. 185 (1932).—The Society of Producers of Tile Stoves in Czechoslovakia has founded a research institute which is managed by Cipera. The grate area of Dutch stoves shall not transgress the 150th part of the total heating area. Research has been started on the construction of continuous heating tile stoves. R.B.

Improvement of Dutch stoves. KAREL HINAIS. *Stavivo*, p. 441 (1931).—The work conducted in Czechoslovakia by high schools, the State Institute for Economic Utilization of Fuels, and the Union of Producers of Stove Tile, which has branches in Bohemia, Moravia, Silesia, and Czechoslovakia, is surveyed. This Union has founded a research institute for standardizing and improving stoves. R.B.

Manufacture of enameled brick. G. MILANI. *Corriere ceram.*, **13** [9], 325–31 (1932).—The enameled brick of the ancient Egyptians and Assyrians reached a degree of perfection which modern skill has not been able to surpass. The manufacture of enameled brick for modern architectural decoration is explained. M.V.K.

Chemical analysis of ancient terra cottas and their origin. ALDA LEVI. *Mouseion*, **15**, 64–66 (1931); *Tech. Studies Field Fine Arts*, **1** [1], 48–49 (1931).—The study of a number of specimens from 10 centers of manufacture showed consistent differences in composition with the localities. (*C.A.*)

Carved brick in Shakespeare memorial. ANON. *Popular Sci. Monthly*, **120** [2], 27 (1932).—Large projecting brick were laid in a wall of the recently completed Shakespeare Memorial Theater at Stratford-on-Avon, England. Eric Kennington, noted sculptor, carved figures from the projecting ends of the brick. Illustrated. F.G.H.

The Prague exposition of architecture and dwelling, 1932. R. BARTA. *Stavivo*, p. 346 (1932).—This exposition, a meeting of technical corporations and an exposition of modern dwellings, was organized by 25 technical corporations at the Baba village near Prague. R.B.

PATENT

Acid-proof structure. J. K. WIRTH. U. S. 1,867,960, July 19, 1932.

White Wares

Some effects of grain size of china clays. HERMANN F. VIEWEG. *Jour. Amer. Ceram. Soc.*, **16** [2], 77–81 (1933).

Simple dispersion test for clays. HEWITT WILSON AND GEORGE A. PAGE. *Jour. Amer. Ceram. Soc.*, **16** [2], 82–85 (1933).

Some notes on the nature of clay. II. F. H. NORTON. *Jour. Amer. Ceram. Soc.*, **16** [2], 86–92 (1933); for Part I see *Ceram. Abs.*, **11** [4], 252 (1932).

Effect of various gaseous atmospheres on the vitrification of ceramic bodies. A. E. BADGER. *Jour. Amer. Ceram. Soc.*, **16** [2], 107–17 (1933).

Effect of repeated heatings on mechanical strength of high-tension insulator porcelains. R. F. GELLER. *Bull. Amer. Ceram. Soc.*, **12** [1], 18–25 (1933).

Ceramic bodies of low absorption maturing below 1000°C. R. F. GELLER AND D. N. EVANS. *Ceram. Ind.*, **20** [1], 32–35 (1933); for abstract see *Ceram. Abs.*, **12** [1], 25 (1933). W.W.M.

Soiling action of mica in fine ceramic raw materials and finished products. F. ZAPP. *Zprávy Československ. keram. společnosti*, **8** [2], 200 (1931); abstracted in *Sprechsaal*, **65** [21], 389 (1932); *Rev. mat. constr. trav. pub.*, No. 272, p. 93*B* (1932).—Potassium mica, $K_2O{\cdot}3Al_2O_3{\cdot}6SiO_2{\cdot}2H_2O$ (muscovite) softens between 1270 and 1380°. Magnesium mica (biotite), which contains 1 to 30% Fe_2O_3 and 10 to 30% MgO besides the constituents of potassium mica, softens at about 1150 to 1170° and under according to the iron content. The varieties of mica must be considered as fluxes from the ceramic point of view. It is important to note that the mica impurities carry iron and titanium. This is the case of biotite, especially, whose Al_2O_3 content can be replaced by Fe_2O_3 and the MgO content by FeO. Comparison grinding tests of a porcelain mass and mica are given and the results tabulated. The differences in grinding are explained by the lamellar structure of the mica which considerably lowers the grinding action. Actually, the mica admixtures in bodies and glazes are less fine than the other part of the ground mass. Firing tests of different mica particles of a comparatively pure muscovite mica showed a brown discoloration and partly melted and partly vitrified products from the coarse grain particles. The finer particles showed gray, free from spots, partly vitrified and partly melted samples. Additions of 5 and 10% of different grain particles to the porcelain mass showed that the particles which do not pass through the 900-mesh sieve produce iron spots, and that the finer particles have no effect. Small additions of muscovite do not produce any defects in porcelain bodies and glazes except when the maximum size of mica is under 0.04 to 0.05 mm. With coarser grains, a local enrichment of the iron content appears in consequence of sintering of the coarser particles leading to the formation of spots. Mica containing much iron and titanium considerably decreases the transparency of porcelain. Porcelain masses are more sensitive to coloring impurities than stoneware and masses for wall tile, although they can be affected by mica also. M.V.K.

Vaporization vessels made of clay. C. KAPNER. *Tonind.-Ztg.*, **56** [98], 1206 (1932).—Porous bodies will allow the vaporization of water from clay vessels. They may be used in connection with steam heating, cooling of butter, etc. W.M.C.

Lead from earthenware vessels: determination of solubility. A. GRONOVER AND E. WOHNLICH. *Z. Untersuch. Lebensm.*, **63**, 623–33 (1932); *Analyst*, **57**, 662 (1932).—As the restriction of importation into Germany of glazed vessels containing soluble Pb is under consideration, the following test is proposed. The vessel, after thorough washing with hot water, is filled to a known mark with boiling 4% acetic acid and is then heated on a water bath for ½ hr. The Pb in the solution is estimated colorimetrically. H.H.S.

Properties of chemical porcelain produced at Merklín. O. KALLAUNER. *Stavivo* p. 301 (1932).—In Czechoslovakia, chemical porcelain is produced at Merklín (M) near Karlsbad and this product not only equals but surpasses the porcelain manufactured at Berlin (B) and Selb (R).

	M	B	R
Specific gravity	2.46	2.39	2.46
Apparent specific gravity	2.39	2.31	2.35
Resistance against acids (Kallauner-Barta method)	95.7	96.5	94.2
P.C.E.	30	28	31
Loss on ignition	0.02	0.04	0.04
Effect of fused sodium carbonate (loss)	9.05	8.58	

R.B.

Chemical composition of Herrebø and Drammen faience. T. LINDEMAN AND O. PRESTRUD. *Tids. Kjemi Bergvesen*, **12**, 121–23 (1932).—Analyses have been made of specimens of faience from the former 18th Century factories at Herrebø and Drammen. The results show that their composition does not differ greatly from that of other faiences, except in respect to the CaO content. The Herrebø ware contains 23.5% CaO, the Drammen ware only 12.7%, whereas the accepted satisfactory upper and lower limits for the CaO content of faience are 22 and 14%, respectively. (*B.C.A.*)

Chemical analysis of some important Chinese clays. T. K. LIU. *Acad. Sinica Inst. Chem. Mem.*, No. 2, pp. 25–45 (1932).—Analyses are reported for 18 Chinese clays. Chinese pottery both ancient and modern has a high content of alkalis. (*C.A.*)

Chemical study of the raw materials used in the I-Hsing potteries. C. WANG. *Science* [China], **16**, 163–79 (1932).—Twelve clays and samples of glaze and biscuit ware

were analyzed. They were high in Fe content and suitable for the manufacture of stoneware. (*C.A.*)

Origin of Chinese porcelain. LUIGI MOSCA. *Corriere ceram.*, **13** [10], 369–73 (1932).—Not until the Han dynasty (202 B.C.) did the Chinese invent porcelain; up to that time only terra cotta was known. Chinese porcelain was brought to Egypt by the Arabs and gradually penetrated into Europe after the beginning of the Christian era, where it was greatly prized. M.V.K.

PATENT

Earthenware body for the manufacture of pottery. J. E. TAMS. Brit. 384,623, Dec. 14, 1932.

Equipment and Apparatus

New gas-fired furnace. ANON. *Chem. Trade Jour.*, **91** [2376], 542 (1932).—A high-temperature furnace for gas heating up to 2000°, manufactured by the stoneware department of the Deutsche Gold- und Silber-Scheideanstalt, makes effective use of the principle of surface combustion. Combustion reactions are greatly accelerated by passing heated solid surfaces, probably a special case of the widespread phenomenon characterized as heterogeneous catalysis of gas reactions and possibly also due to the catalytic effect of the solid surfaces. In this new furnace the gases are not mixed prior to entering, while the necessity for high pressure is avoided by the greatest possible reduction of the resistance to the gas passing through the furnace. The furnace has an internal lining of magnesia and zirconium oxide. The internal working space is concentrically surrounded by a mantle, the annular space between being the actual combustion chamber. The gases (air and coal gas) are not mixed until they enter the combustion chamber; back firing is therefore impossible. M.V.K.

Universal melting furnace for high temperatures. HUGO HELBERGER. *Eng. Progress*, **13** [12], 260 (1932).—A melting furnace capable of attaining temperatures up to 3000°C is described. A graphite or carbon crucible is placed in the secondary circuit of an a.-c. transformer to form the resistance and it thus becomes heated by the passage of the current. Illustrated. J.L.G.

High-frequency furnaces. E. FR. RUSS. *Giesserei*, **19**, 270–73, 284–88, 309–12 (1932).—The T.-H. Charlottenburg, Ribaud, Ajax-Northrup, Lorenz, Siemens-Halske, and Fischer high-frequency furnaces and accessories are briefly described, the basic theory being outlined. (*C.A.*)

Crushers and crushing. E. DE LA FOLLYE DE JOUX. *Rev. mat. constr. trav. pub.*, No. 278, pp. 453–57 (1932).—The developments of modern crushing apparatus are discussed. M.V.K.

Crushing and crushing apparatus. E. G. GUERRÉE. *Rev. mat. constr. trav. pub.*, No. 276, pp. 168–72*B* (1932).—A detailed discussion is given of the technique of crushing and devices used. M.V.K.

Fineness of grinding in industry. A. H. M. ANDREASEN. *Tek. Tid., Uppl. C, Kemi*, **62**, 6–8, 12–15, 20–24 (1932).—A. discusses the practical importance of knowing the fineness of materials employed for the various technical purposes, such as pigments, abrasives, cement, ceramics, ores, etc. The determination of the space between particles at certain particle sizes is treated mathematically. The various methods and devices employed to produce materials of a certain fineness are described. See also *Ceram. Abs.*, **11** [7], 428 (1932). (*C.A.*)

Measurement of particle size with an accurate air analyzer; fineness and particle size distribution of Portland cement. P. S. ROLLER. *Proc. A.S.T.M.*, **32** [Part II], 607–28 (1932).—A number of improvements have been made in an apparatus previously described (*Ceram. Abs.*, **10** [6], 448–49 (1931)) for determining the particle-size distribution of fine powder by air separation and weighing of the fractions. R.A.H.

Hydraulically operated testing machine. TOLEDO PRECISION DEVICES, INC. *Foundry*, **60** [6], 98 (1932).—A recently developed testing machine designed for compression, tension, and transverse bending tests is described and illustrated. The force is applied by a hydraulic press and the device is designed to operate at any desired speed. F.G.H.

Full-load calibration of a 600,000-lb. testing machine. H. F. MOORE, J. C. OTHUS, AND G. N. KROUSE. *Proc. A.S.T.M.*, **32** [Part II], 778–82 (1932).—The paper describes the calibration of a screw power, balance-beam testing machine of 600,000-lb. capacity. R.A.H.

Calibration of temperature indicators. N. F. HINDLE. *Foundry*, **60** [5], 58–60 (1932).—H. portrays the history of pyrometry from the time of Newton to the present. The two classes of thermoelectric pyrometers, those employing base metals and those employing noble metals, and their subdivisions are discussed with respect to composition and range of application. The requirements for proper functioning of thermocouples are pointed out and the need for insulation is emphasized. The comparison method and the freezing point method for the calibration of thermocouples are described in detail. Charts and curves are included. F.G.H.

Further notes on an apparatus for the continuous recording of p_H. A. E. J. VICKERS, J. A. SUGDEN, AND R. A. BELL. *Chem. & Ind.*, **51** [45], 923 (1932).—Recent refinements of the apparatus previously described (*Ceram. Abs.*, **11** [12], 625 (1932)) are discussed. G.R.S.

Autoclaves. G. T. MORGAN. *Chem. & Ind.*, **51** [51], 1029 (1932).—The history, types, and uses of autoclaves are discussed. G.R.S.

Smoke-density meter. R. D. BEAN. *Jour. Sci. Instruments*, **9** [12], 391 (1932).—A device developed by the Brown Instrument Co. of Philadelphia measures the density of smoke in flue gases by electro-optical means. J.L.G.

Recent improvements in photoelectric cells. NORMAN R. CAMPBELL. *Jour. Sci. Instruments*, **9** [12], 369–73 (1932).—A short discussion of modern photoelectric cells, including their characteristics and application to practical use, is given. J.L.G.

Photoelectric recorder has high sensitivity. C. W. LA PIERRE. *Power*, **75** [20], 742–43 (1932).—A photoelectric recorder that combines the advantages of direct-acting recorders with those of a sensitive indicating instrument has a separately excited recording element to make the record and a sensitive indicating instrument to control the movement of the recording element so that the record obtained represents the reading of the basic instrument. Illustrations and diagrams. F.G.H.

Modified electro ultrafilter. D. VON KLOBUSITZHY. *Jour. Phys. Chem.*, **36** [12], 3189–90 (1932).—An electro ultrafilter easily mounted for common use is described. G.R.S.

Balance for fast determination of densities. W. KRÄTSCHMAR. *Centr. Mineral. Geol.*, **A**, No. 6, pp. 221–24 (1932).—The customary balance is modified to render it a direct-reading instrument. (*C.A.*)

Micropyrometer for determining the melting points of metals. ANON. *Foundry*, **60** [9], 60 (1932).—The construction and operation of an ingenious micropyrometer are described and illustrated. F.G.H.

NCT3: A recent addition to the heat-resisting alloys. J. L. EVERHART. *Power*, **75** [5], 174 (1932).—The physical properties and industrial applications of this chrome-nickel-iron alloy are described. F.G.H.

Driers and drying in refractories industry. J. T. ROBSON. *Bull. Amer. Ceram. Soc.*, **12** [1], 2–17 (1933).

Fundamentals and economies in the clay industries. XXII. ELLIS LOVEJOY. *Clay-Worker*, **98** [6], 228–30 (1932).—The most widely used drier is the waste-heat progressive drier. The principle involved is that of introducing the ware at one end and the hot air at the other, the two traveling in opposite directions. Some of the points preventing this being an ideal situation are enumerated. The great fault is the lack of circulation among the ware. Capacity operation is necessary in order to obtain the most economic results from progressive driers of this type. Drier balance is discussed and its importance is stressed. For Part XXI see *Ceram. Abs.*, **12** [1], 29 (1933). E.J.V.

De-airing of clay. CHAMBERS BROTHERS CO. *Brit. Clayworker*, **41** [488], 291 (1932).—The de-airing chamber as applied to the auger extrusion machine is described. R.A.H.

Observations on the life of filter-press cloths. F. W. FREISE. *Seifensieder-Ztg.*, **59**, 277–80 (1932).—Filter cloths for presses of 320 to 50 atmospheric pressure and 400 x 400 x 120-mm. cakes were handmade of horsehair, camel's hair, cow's-tail hair, cotton, wool, Chinese human hair, and several native fibers. They were tested before and after pressing up to 300 pressings. The order of increasing loss of tensile strength was as follows: aramina, banana, tuzum, Chinese human hair, horsehair, camel's hair, wool, cotton, and goat's hair. Animal fibers permit greater filtration capacity than vegetable fibers, and also suffer a greater loss of fibers by adherence to press cakes. Cold pressing prolongs the life of the cloths, while a temperature of 60° considerably shortens it. Rapid high pressure is more detrimental than slow high pressure. Rough filter plates attack the fiber, smooth plates tend to felt it. Used cloths suffer greatly by acidity developed during nonuse. The presence of a certain amount of lignin in vegetable fibers prolongs their life. (*C.A.*)

Cemented tungsten carbide for cutting tools. L. J. St. Clair. *Trans. A.S.M.E.*, **53** [MSP-15], 139–46 (1931); abstracted in *Mech. Eng.*, **54** [2], 150 (1932).—S. tells of the origin of cemented tungsten carbide and the most satisfactory method for making it. Because of its hardness, it is valuable for wear-resisting tools and particularly for cutting tools. The physical properties of cemented tungsten carbide and its economic value as a cutting medium are discussed. Design and care of the tools are essential factors in successful application. Proper support of the cemented tungsten carbide tip and allowance for proper clearance angles are essentials of design. The tool set-up should be as rigid as possible, as chatter or vibration is detrimental to successful life. The critical speed at which the tool should run for a particular job should be determined and the machine should be operated below this. Grinding of the tool is important and proper grinding methods are given. Use of cemented tungsten carbide for cutting tools has resulted in increased machine speed, longer life per grind, reduced tool maintenance, less waste of material in setting up, and greater accuracy throughout a long run. F.G.H.

Haynes stellite cutting tools. W. A. Becker, E. E. Gordon, and W. A. Wissler. *Trans. A.S.M.E.*, **53** [MSP-11*a*], 93–100 (1931); abstracted in *Mech. Eng.*, **54** [2], 149 (1932).—This paper describes briefly the physical properties of Haynes stellite and gives the more important details of several types of machining operations on which it is being successfully used. Its most important property is red hardness. Measurements of hardness were made by an improved method up to 1100°C. The resulting data show that stellite is harder than high-speed steel at temperatures above 500°C. This is believed to account for its superior cutting quality. In general, stellite bits and blades can be used economically on all operations on cast iron, semisteel, malleable iron, bronze, or similar metals and on mild steel if the section is heavy and the tools are rigidly supported. It has not been successful on automatic or semiautomatic machines for cutting steel. Illustrations and graphs. See also *Ceram. Abs.*, **9** [11], 993 (1930). F.G.H.

Single- and double-deck vibrating screens. Link-Belt Co. *Foundry*, **60** [6], 99 (1932).—Two new types of vibrating screens are described, one a positive-drive type, heavy-duty vibrating screen, and the other an unbalanced-pulley type, heavy-duty vibrating screen. Illustrated. See also *Ceram. Abs.*, **11** [9], 498 (1932). F.G.H.

Testing sieve shaker with two motions. Newark Wire Cloth Co. *Foundry*, **60** [12], 66 (1932).—A testing sieve shaker is described in which the mounted sieves are given a combined reciprocating and slowly rotating motion, the motor being geared through a worm and wheel. The mechanism is enclosed entirely, and operates in oil to prevent wear of vital parts and also to muffle noises that might be developed. Illustrated. See also *Ceram. Abs.*, **11** [10], 536 (1932). F.G.H.

Development of tubular mills. L. Pledit. *Rev. mat. constr. trav. pub.*, No. 277, pp. 417–20 (1932).—The principles of working of tubular mills and their improvement are discussed. M.V.K.

Ball bearings for roller conveyers. Logan Co. *Foundry*, **60** [12], 66 (1932).—A simple labyrinth construction is used in places where fine abrasive dust is present. Dust particles which enter the labyrinth are thrown out either by force of gravity or centrifugal force. F.G.H.

Rationalizing fan selection. C. A. Carpenter. *Power*, **75** [25], 924–25 (1932).—The calculation of maximum and minimum pressure-volume relations and the influence of the latter on fan application are described. Illustrated with graphs. F.G.H.

Alternating current motors for ventilating fans. J. A. Jackson. *Power*, **75** [10], 366–68 (1932).—The 50% speed range generally specified for d.-c. motors driving ventilating fans is considered excessive for most installations; a.-c. motors do not lend themselves as readily to speed adjustment, hence speed change should be kept as small as possible. Methods for doing this are suggested. F.G.H.

Motors and control for fans, blowers, and exhausters. E. C. Dieffenbach. *Power*, **75** [21], 758–62 (1932).—D. gives a summary of motors and control available, subdivided into (1) power, alternating current and direct current, (2) speeds, constant or variable, and (3) torque requirements helpful in a study of electric drives for fans or blowers. Definite applications in successful operation are described. Illustrated. F.G.H.

Constant *versus* variable speed for auxiliary drives. E. H. Throckmorton. *Power*, **75** [13], 466–68 (1932).—T. makes an economic comparison between variable- and constant-speed motor drive for a forced-draft fan. The method shown applies equally well to other problems in this field. F.G.H.

Vibration in high-speed motors; its causes and remedies. D. Turcott. *Power*,

75 [9], 329–31 (1932).—The causes of this vibration, in which critical speed is a major factor, are considered and suggestions are made on how the trouble may be avoided. F.G.H.

Lubrication and machine life. A. F. BREWER. *Power*, **75** [6], 194 (1932).—The relation of proper lubrication to the repair costs and total life of a machine is discussed F.G.H.

Effect of speed, temperature, and pressure upon lubrication. A. F. BREWER. *Power*, **75** [10], 357–59 (1932).—B. shows that the effects of speed, temperature, and pressure existing at the point of application must be anticipated in order to make possible the successful lubrication of machinery. F.G.H.

Proper care of insulating oil reduces maintenance costs. M. PHILLIPS. *Power*, **75** [11], 398–400 (1932).—The life and satisfactory operation of oil-immersed electrical equipment depend on the oil's condition. A schedule of routine maintenance and inspection of all insulating oils should be carefully followed on all oil-immersed equipment. Illustrated. F.G.H.

Modern designs for transporting and loading. ANON. *Tonind.-Ztg.*, **56** [91], 1125–26 (1932). W.M.C.

Transportation. E. ARTUS. *Tonind.-Ztg.*, **56** [93], 1149–50 (1932).—The Fuller-Kinyon pump for transporting loose materials such as cement, lime, plaster of Paris, soda, magnesite, etc., is described. Illustrated. W.M.C.

BULLETIN

Ventilating fans. L. J. WING MFG. CO. *Foundry*, **60** [11], 72 (1932).—Construction details, safety features, capacities, dimensions, and prices feature this bulletin on ventilating fans. Other heating and ventilating products are mentioned such as exhausters, heaters, and cooling fans. F.G.H.

PATENTS

Method and apparatus for electrically fusing nonconducting materials. R. R. RIDGWAY (Norton Co.). U. S. 1,893,106, Jan. 3; 1933.

Hydraulic variable speed control. C. H. ROBERTS (D. M. Morris). U. S. 1,893,654, Jan. 10, 1933.

Viscosity apparatus. P. E. KLOPSTEG (Central Scientific Co.). U. S. 1,893,749, Jan. 10, 1933.

Temperature measurement. F. S. MARCELLUS (General Electric Co.). U. S. 1,894,109 and 1,894,110, Jan. 10, 1933.

Color analyzer. C. W. STONE (General Electric Co.). U. S. 1,894,132, Jan. 10, 1933.

Episcopes or apparatus for the projection of opaque objects. P. L. CHARLIER, Brit. 385,104, Dec. 28, 1932.

Apparatus for measuring temperatures of furnaces, etc. COMPAGNIE FRANÇAISE POUR L'EXPLOITATION DES PROCÉDÉS THOMSON-HOUSTON. Fr. 727,000, Nov. 28, 1931. (*C.A.*)

Press for repressing hollow refractory shapes. WESTERN BOHEMIA REFRACTORIES AND KAOLIN WORKS. Czechoslo. 6163–30, 1929. Pressure is applied to the shape in both axial directions and the press is especially useful for repressing hollow stiff-mud shapes. R.B.

Kilns, Furnaces, Fuels, and Combustion

Modern waste-heat tunnel driers. T. W. GARVE. *Jour. Amer. Ceram. Soc.*, **16** [2], 118–23 (1933).

Tunnel kilns for firing roofing tile. F. SINGER. *Tonind.-Ztg.*, **56** [91], 1121–23 (1932).—The manufacture of large quantities of roofing tile in Germany has led to the use of tunnel kilns. The advantages of these kilns in comparison with the ordinary kilns are as follows: The furnace can be adapted to almost any kind of raw material which otherwise might not be used for the manufacture of roofing tile. The dimensions of the tunnel kilns may be varied considerably, according to the output desired. The firing of the tunnel kiln may be done by means of any method now in use in periodic and continuous kilns. Illustrated. W.M.C.

Tunnel kiln in movable sections. ANON. *Brit. Clayworker*, **41** [487], 263 (1932); for abstract see *Ceram. Abs.*, **11** [10], 537 (1932). R.A.H.

Kiln with isolable chambers. ANON. *Brit. Clayworker*, **41** [488], 293 (1932).—A kiln has recently been patented in Germany in which it is possible to shut off certain chambers from the general round of a continuous kiln and finish these chambers independently from the rest of the kiln. A brief description of the kiln is given. R.A.H.

Kilns which may be fired and cooled at any rate. J. F. KÜHNEL. *Stavivo*, p. 359 (1931).—K. believes that too great stress is being laid upon heat economy of ceramic kilns, and that other factors are being neglected which are essential for the production of ware of the best quality. Optimum temperatures for the formation of mullite in porcelain kilns are of greatest importance, as well as cooling rates and cooling schedules for sewer pipe. Brittleness of paving brick may be reduced if, during the cooling period, the ware is moderately heated and then cooled again. A tunnel kiln and a chamber kiln are described which are constructed so that the single firing periods may be regulated to attain optimum temperatures, keep the ware at these temperatures, and create other conditions necessary for best quality of products. 6 figures. R.B.

Economical setting in annular kilns. JOSEF PRÁŠIL. *Stavivo*, p. 90 (1932).—Every year the Society for the Encouragement of the Brick Industry awards prizes to brickmakers for improvements and thus increases interest in technical progress. P. recommends setting brick on the floor of the kiln to form a grate; two parallel continuous traces of brick are laid flat along the kiln in the direction of the firing eyes so that a small flue of about 20 cm. in width is formed which is arched with brick laid flat across. Thus a grate is formed through which hot air streams, and the floor of the kiln is heated so that quick progress of fire and perfect combustion of fuel are attained. Illustrated. R.B.

Grates for the firing eyes of annular kilns. A. CHMELÍČEK. *Stavivo*, p. 113 (1932).—Under every eye a bench is built about 15 cm. above the floor from brick laid flat and 4 brick standing upright across the corners of the bench. Such grates give less resistance to draft and therefor may be used for kilns with little draft. For bituminous and brown coals groups of 3 brick are laid and for coals poor in gases groups of two brick are laid. Thus equal distribution of fuel and a more perfect combustion may be obtained. R.B.

Drying ware in annular kilns. A. MODRÁČEK. *Stavivo*, p. 137 (1932).—The drying apparatus consists of a flue built between the furnace and the main flue through which heat from the cooling chambers is led to chambers set with green ware. The heat does not leave the kiln by the shortest way, as is often asserted, but rises to the highest part of the chambers and sinks down gradually. By removing the covers from the firing eyes, heat is not forced into the lower parts of the kiln, as many believe, but cold air is admitted. Thus the draft is lowered and must be equalized by causing flue gases of higher temperature to pass through the stack so that loss of heat is the result. R.B.

Economy in firing annular kilns in brickworks. FR. HÖNIG. *Stavivo*, 1932.—The advantages of mechanical stoking are described. R.B.

Selection of different kiln types for small brickworks. B. HELAN. *Stavivo*, p. 161 (1932).—According to Kallauner, 3 billion brick of the dimensions 29 x 14 x 6.5 cm. are made in Czechoslovakia yearly by about 2500 hand-molding and 500 mechanical brickworks. The Satoplet kiln for use in small brickworks is a single-chamber kiln with crown and grate furnaces. The furnaces are one-half of the width of the kiln and are closed by walls of unfired brick to two-thirds of the kiln's height. Periodic downdraft kilns are built for firing 20,000 to 30,000 brick. Multiple-chamber kilns have 2 to 4 chambers. Partial-chamber kilns, *e.g.*, Habla, Kohout, Kotvald, Klein, Repnic, Silesian, etc., where heat is drawn through in different ways, are more advantageous. By uniting two such partial kilns a double partial kiln is obtained which may be fired continuously. The Habla kiln is this type. Another type having only a few chambers is called the Lilliput kiln and is built by Klein, Vott, Kohout, and Tischler. For continuous firing the length of the kiln must be 40 m. at least. The Pössner kiln has a series of chambers arranged in a ring with reversible fire progress. Illustrated. R.B.

Changing a rectangular kiln to a zigzag kiln in an Indian brick plant. L. SCHIELE. *Tonind.-Ztg.*, **56** [96], 1181–82 (1932).—This plant was reorganized by altering the preparation of the raw materials, improving the drying sheds, and building a continuous kiln. W.M.C.

New type of furnace. R. SELZER. *Tonind.-Ztg.*, **56** [97], 1195 (1932).—In a furnace developed to fire ceramic products the waste heat is used in a recuperator similar to a glass tank. W.M.C.

Smoke-prevention appliance. ANON. *Brit. Clayworker*, **41** [487], 262 (1932).—The tuyère ridge furnace forms a part of the grate surface, the object being to provide secondary air along the whole length of the grate instead of at the fire bridge. This

purpose is achieved by placing the metal units composing the tuyère ridge in the center of the fire grate after removing a few of the middle fire bars of the furnace. R.A.H.

Factors to consider in classification of coal. A. BEMENT. *Power*, **75** [5], 173–74 (1932).—The comparison of different coals on the basis of relative chemical characteristics and size is discussed. F.G.H.

Low-temperature carbonization as an aid to the coal industry. J. D. MCQUADE. *Explosives Eng.*, **10** [6], 174–75 (1932).—Slack or screenings constitute 20 to 35% of the entire production of the average bituminous mine. Low-temperature carbonization of this material yields commercially valuable by-products and a residual fuel that is high in carbon content and excellent as a fuel. Methods for producing this fuel and its industrial applications are discussed. F.G.H.

Economic utilization of fuel. F. W. BURSTALL. *Gas Jour.*, **200** [3629], 699–700 (1932).—A discussion is given of gaseous fuels. G.R.S.

Economic aspects of colloidal or coal-oil fuel. J. S. S. BRAME. *Gas Jour.*, **200** [3622], 219–20 (1932).—Advantages and disadvantages of this type of fuel are pointed out. A discussion of the paper is given. G.R.S.

Firing with heavy oil. ANON. *Rev. mat. constr. trav. pub.*, No. 278, pp. 217–18*B* (1932).—The paper discusses the utilization of heavy oil for firing ceramic products in round furnaces, furnaces with direct flame and reversed flame, etc. The results of firing Sèvres and Limoges porcelain with heavy oil have been satisfactory. Data on the consumption and cost are given. M.V.K.

Fuel oil in metallurgical melting and heating practice. T. F. UNWIN. *Metallurgia*, **7** [38], 49–50 (1932).—Factors which have led to the use of fuel oil are discussed. Proper oil furnaces specially designed to obtain the advantages from fuel oil are stressed, and consumption figures are given as a guide to its economy in use for a wide range of metallurgical operations. M.V.K.

Regulating natural gas fires for best efficiency. N. E. EBAUGH. *Power*, **75** [18], 656–57 (1932).—E. discusses heat losses which occur when natural gas is used as a fuel. A chart is illustrated which, when used with an Orsat flue-gas analysis for CO_2 and O_2, shows the corresponding CO, excess air, and total flue loss for a natural gas consisting mainly of methane. With this information burners can be regulated to give the most efficient combustion of fuel. F.G.H.

Gas as fuel for pottery firing. ANON. *Feuerfest*, **8** [10], 158 (1932); for abstract see *Ceram. Abs.*, **11** [12], 639 (1932). M.V.K.

Electricity for firing ceramic ware. A. S. BERKMAN. *Keram. i Steklo*, **8** [8], 17 (1932).—B. discusses the advantages of electric furnaces for firing ceramic products over those using coal and liquid fuel. M.V.K.

Behavior of solid fuels during oxidation. BURROWS MOORE. *Fuel Sci. Prac.*, **10** [7], 293–96; [8], 344–49; [9], 394–400 (1931); abstracted in *Metals & Alloys*, **3** [8], 256 (1932).—Increasing the O temperature causes an increased rate of combustion and heat evolution during the pre-ignition period, which, in the case of cokes, decreases soon after ignition and remains practically uniform for a considerable period during which the rate of heat produced by the oxidizing fuel is nearly equal to the rate of heat loss from the fuel. It does not increase the mean or maximum temperature attained by the combustion. It tends to insure more complete combustion in the case of fuel charges which are not widely dispersed, *e.g.*, fine particles in the O or air used for combustion. It does not greatly affect the rate of heat loss from the fuel during the combustion. The considerable difference between O temperatures, which may exist when the ignition and combustion characteristics of fuel with considerably different glow-point temperatures are compared, does not introduce serious errors in estimates of ignition factors and combustible capacities by the method employed. It does not greatly increase the combustible capacity of the fuel. There is no advantage in processes using powdered fuel for firing purposes in increasing the O or air temperature above the ignition temperature. See also *Ceram. Abs.*, **12** [1], 31 (1933). E.P.R.

Combustible losses in flue gases. I. J. D. KELLER. *Heat Treating & Forging*, **18** [9], 543 (1932).—Improved Ostwald charts for stack gas analysis are given for coal, natural gas, fuel oil, coke-oven gas, city gas, and producer gas. All the charts are calculated on the basis that the volume of H_2 equals the volume of CO and that the combustion products contain neither hydrocarbons nor soot. The method of calculating and using the charts is explained. **II.** *Ibid.*, **18** [10], 595–98 (1932).—Complete and incomplete combustion are considered together with sample calculations for each instance. Methods of calculating the heat losses caused by the escape of unconsumed gases are given. J.L.G.

Laboratory determination of flue gas. AGDE AND GÖLZ. *Feuerungstechnik*, **20** [10], 145–47 (1932).—A simple and comparatively exact laboratory method for determining the combustion products of fuel and the resulting flue gases is described. M.V.K.

Recirculation of flue gases and preheating of air. WILHELM GUMZ. *Feuerungstechnik*, **20** [10], 147–49 (1932).—G. discusses (1) the mathematical determination of the action of flue gas, and recirculation with the help of the "It-diagram"; (2) lowering of the temperature through flue-gas recirculation and raising the temperature through preheating the air; (3) upper and lower limiting value of the temperature decrease; (4) advantages and practical possibilities of the recirculation of flue gases; and (5) investigations of Slooves (*Ingenieur*, No. 13 (1931)). M.V.K.

Mechanical stoking and color of brick. A. CHMELÍČEK. *Stavivo*, 1932.—The best color for roofing tile and brick fired in annular kilns is obtained by firing with coke dust. Coal fines do not burn out as well as coke dust and the gases produced from them have an unfavorable effect on the brightness of the color of the ware. High temperatures may be attained by using coke dust. R.B.

Combustion of pulverized coal in metallurgical furnaces. P. M. MCNAIR. *Foundry Trade Jour.*, **47**, 85–86 (1932); abstracted in *Foundry*, **60** [11], 52 (1932).—Modern ideas on the combustion of pulverized coal are discussed briefly under the following headings: (1) unit *vs.* central system of pulverizing, (2) grinding fineness, (3) mixing of fuel and air, (4) preheating coal and air, (5) rapid ignition, (6) heat release per unit volume, and (7) bituminous coal as compared with anthracite coal. Advantages of preheating air are mentioned, but it is pointed out that care must be exercised to prevent the temperature approaching the ignition point of the coal. F.G.H.

Automatic control adjusts air to mixed gases. K. A. MAYR. *Power*, **75** [2], 63–64 (1932).—An apparatus developed in Germany automatically proportions air to the heating value of the changing mixture of two gases. This system may find application in furnaces using two fuels simultaneously. F.G.H.

Study of reducing atmospheres. L. D. *Rev. mat. constr. trav. pub.*, No. 276, pp. 166–68*B* (1932).—The meaning of the term "reducing atmosphere" is explained, and the action of a number of reducing gases on different metallic oxides is discussed. The variation in colors and the realization of reducing atmospheres in different types of furnaces are treated, and suggestions are given for obtaining the desired results. M.V.K.

Life and characteristics of Orsat reagents compared. ANON. *Power*, **75** [21], 756–57 (1932).—The durability and speed of absorption of different strength solutions for the absorption of oxygen and carbon dioxide are discussed in detail. Capillary and bubbling pipettes are also compared. Illustrated. F.G.H.

Gas generator. RAILWAY LOCOMOTOR CO. *Foundry*, **60** [11], 72 (1932).—A self-contained generating unit operating on a standard liquid fuel for all industrial heating applications is described. It is pointed out that in core ovens, annealing ovens, kilns, and similar applications, a low fuel consumption is secured with the device and temperatures may be maintained and controlled with great accuracy. Illustrated. F.G.H.

Paper partitions. A. CHMELÍČEK. *Stavivo*, p. 47 (1932).—The paper partition is lifted like a curtain by means of a wire which is about 50 cm. above the kiln floor. Thus heat is compelled to pass through the lower parts of the kiln. By opening the covers of the firing eyes, heat is forced downward from the crown. After 10 to 12 hr. at a temperature of about 250°C the paper carbonizes and burns away. Illustrated. R.B.

BOOK

A Textbook of Heat Including Kinetic Theory of Matter, Thermodynamics, Statistical Mechanics, and Theories of Thermal Ionization. M. N. SAHA AND B. N. SRIVASTAVA. xxv + 771 pp. The Indian Press, Ltd., Allahabad, 1931. Reviewed in *Nature*, **130** [3291], 794–95 (1932).—This is one of the best advanced textbooks on heat. The treatment is largely theoretical with the experimental side much condensed. J.L.G.

PATENTS

Preparation of titanium pigments. JOSEPH BLUMENFELD AND MAX MAYER (Krebs Pigment and Color Corp.). U. S. 1,892,693, Jan. 3, 1933. In the preparation of a titanium pigment, the steps comprise mixing moist titanium oxide with less than 2% of alkali carbonate in the presence of sulfate ions, calcining the mixture, and washing the calcined materials to remove the water-soluble residue.

Tunnel kiln car. H. W. H. BETH (Norton Co.). U. S. 1,893,123, Jan. 3, 1933.

A ware-supporting plate for tunnel kiln cars comprises a slab of refractory material having an opening therethrough which extends inwardly from the edges to compensate for expansion and contraction of the material due to thermal changes.

Furnace. H. C. JURS. U. S. 1,893,898, Jan. 10, 1933. In a furnace of the muffle type, a series of walls defining a firing chamber, a flat type roof forming the top of the chamber, a floating flue structure intermediate the roof and walls, and muffles carrying the flue structure.

Kiln for the heat treatment of materials. H. C. ERITH AND R. C. ERITH. U. S. 1,894,167, Jan. 10, 1933.

Tunnel kilns. WOODALL-DUCKHAM, LTD., AND A. N. TARRANT. Brit. 384,011, Dec. 7, 1932.

Ceramic tunnel kiln. HOLDING GESELLSCHAFT FÜR KERAMISCHE WERKE. Ger. 553,803, Feb. 7, 1928. TAINE GILBERT MCDOUGAL. Ger. 553,804, Feb. 25, 1927. (*C.A.*)

Tunnel kiln for earthenware. NICOLA LENGERSDORFF. Ger. 554,692, Jan. 10, 1928. (*C.A.*)

Firing ceramic goods. ARTHUR S. WATTS. Ger. 556,056, June 16, 1929; for patent see *Ceram. Abs.*, **9** [12], 1089 (1930). (*C.A.*)

Circular brick kiln. N. G. VEISBURG AND A. S. VEISBURG. Russ. 25,898, March 31, 1932. (*C.A.*)

Geology

Structure of bertrandite, $H_2Be_4Si_2O_9$. T. ITO AND J. WEST. *Z. Krist.*, **83** [5–6], 384–93 (1932).—The structure of bertrandite was determined by X-ray analysis using oscillation photographs (CuK_α and $MoK_{\bar{\alpha}}$ radiations) and the ionization spectrometer ($Rh–K_\alpha$ radiation). The space group is C_{2v}^{12} and the unit cell has dimensions a = 15.19Å, b = 8.67Å, c = 4.53Å, containing four molecules of $H_2Be_4Si_2O_9$. The arrangement of the atoms is described. G.R.S.

Crystal structure of dickite. J. W. GRUNER. *Z. Krist.*, **83** [5–6], 394–404 (1932).—The structure of dickite was examined by the powder method. The dimensions of the monoclinic unit cell are a_0 = 5.14Å, b_0 = 8.94Å, c_0 = 14.42Å, β = 96°50′. The cell contains 4 molecules $(OH)_4Al_2Si_2O_5$. The theoretical density is 2.589. The space group is C_s^4. Dickite is closely related to kaolinite, both being layer or sheet structures. The individual layers are practically identical in both minerals. They differ only in the directions and magnitudes of the shifts of these layers over one another. G.R.S.

Structure of potassium dithionate, $K_2S_2O_6$, and the measurement of the integrated reflection from a small crystal. G. V. HELWIG. *Z. Krist.*, **83** [5–6], 485–92 (1932).—A solution for the structure of potassium dithionate is proposed. A satisfactory method of obtaining quantitative X-ray data with small crystals is described. G.R.S.

Crystal structure of calcium metaborate, CaB_2O_4. W. H. ZACHARIASEN AND G. E. ZIEGLER. *Z. Krist.*, **83** [5–6], 354–61 (1932); for abstract see *Ceram. Abs.*, **11** [3], 207 (1932). G.R.S.

Physicochemical properties of clay. G. WIEGNER. *Mitt. Lebensm. Hyg.*, **22**, 327–46 (1931); *Chem. Zentr.*, **i**, 2758 (1932); for abstract see *Ceram. Abs.*, **10** [7], 522 (1931). (*B.C.A.*)

Quantitative crystalline analysis by means of X-rays. M. E. MAHMIAS. *Z. Krist.*, **83** [5-6], 329–39 (1932).—After unsuccessfully trying different tests based on methods already existing, M. devised a technique which permits the determination of a crystalline species in a mixture of two or three crystalline constituents. G.R.S.

Methods in microscopy. GEORGE L. KEENAN. *Jour. Assn. Official Agric. Chem.*, **15** [4], 626–29 (1932).—The use of the polarizing microscope in the identification of crystalline materials is explained. The methods available for petrographic determinations and some of the theories underlying them are briefly discussed. J.L.G.

Dehydration experiments with bauxites and bauxite minerals. JÓZSEF GYÖRKI. *Földtani Közlöny*, **61**, 64–67 (in German 68–94) (1931).—The hydrated minerals of bauxites can be exactly characterized by means of dehydration numbers and curves. Hydrargillite and diaspore decompose at a lower temperature than stated in the literature. Their dehydration curves are quite different; this shows that the OH bindings in them also are different. The dehydration curves of bauxites show of which of these minerals they are composed. Silica is mostly found as $Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O \cdot xH_2O$. The

bauxites of Gánt (Hungary) are mixtures of compounds formed by natural chemical reactions. See also abstract by Dittler, *Ceram. Abs.*, **11** [7], 418 (1932). (*C.A.*)

Origin of pisolitic bauxites. TIHAMÉR GEDEON. *Földtani Közlöny*, **61**, 95–100 (1931).—A series of analyses of the Hungarian bauxite occurrences is published. The pisolitic parts of bauxites seem to be structureless (Lapparent). In bauxites from Gánt, the content of SiO_2 and TiO_2 was always smaller and that of Fe_2O_3 higher in the pisolite than in the normal bauxite. The pisolites are due partly to the formation of concretions under the influence of rains, and partly to secondary transportation. (*C.A.*)

Formation of kaolin in a warm, damp climate. J. GREWE. *Tonind.-Ztg.*, **56** [88], 1086 (1932).—Further proof of the influence of a warm, damp climate on the formation of kaolin, as outlined by Dittler (*Tonind.-Ztg.*, **56** [75], 939 (1932)) is seen in the recent discovery of kaolin in southwestern Norway close to the warm Gulf Stream. W.M.C.

Effect of pressure on kaolin suspensions. RUDOLF LORENZ. *Wochbl. Papierfabr.*, **63** [Sondernummer 23*A*], 22–25 (1932).—The observation of Ostwald and Pieckenbrock (*C.A.*, **18**, 2792), that pressing clay suspensions through a capillary increases the viscosity due to mechanical subdivision of particles, is confirmed. Any mechanical action such as vigorous stirring has a like but less marked effect. Such treatment does not serve to render plastic a "short" clay. Paper clay can not be converted to ceramic clay by such means or *vice versa*. (*C.A.*)

Note on the formation of kaolin minerals from feldspar. A. E. BADGER AND A. ALLY. *Jour. Geol.*, **40** [8], 745–47 (1932).—The action of dilute hydrofluoric acid at about 225°C on a potash feldspar powder is shown to result in the formation of a kaolin mineral, probably kaolinite or dickite. Carbonic acid under 1800-lb. pressure produced no apparent alteration of this feldspar after 156 hours' treatment at 60°C. G.R.S.

Isomorphism of the feldspar minerals. E. SCHIEBOLD. *Neues Jahrb. Mineral. Geol., Beil. Bd.*, **A64**, 251–320 (1931).—X-ray data on the K, Na, and Ca feldspars with structural formulas are reviewed. Data on the relative stability of structures of the types $M^{I}_2M^{III}_2Si_2O_8$ and $M^{II}M^{III}_2Si_2O_8$ are given. A discussion of the crystal structure of nephelite is included. (*C.A.*)

Removal of iron from minerals. F. REINHART. *Tonind.-Ztg.*, **56** [94], 1161–62 (1932).—This is a review of recent patents relating to this subject. W.M.C.

Physical chemistry of the magmatic differentiation of igneous rocks. III. Granitic rocks. J. H. L. VOGT. *Skrifter Norske Videnskaps-Akad. Oslo*, No. 3, pp. 1–242 (1931); *Sci. Progress*, **27**, 214–15 (1932); for abstract see *Ceram. Abs.*, **12** [2], 76 (1933). H.H.S.

Compaction of sediments. PARKER D. TRASK. *Bull. Amer. Assn. Petroleum Geol.*, **15** [3], 271–76 (1931).—The initial water content of sediments varies with the fineness of the constituent particles. A tentative estimate indicates that it is approximately 45% in well sorted fine-grained sands, 60% in silts, 80% in clays, and more than 90% in colloids. In general, deposits that accumulate over submerged ridges are coarser than those that form in basins. Consequently, sediments deposited on submarine topographic "highs" should compact less than those that accumulate in "lows." G.M.H.

Black shale deposition in central New York. EDWARD W. HARD. *Bull. Amer. Assn. Petroleum Geol.*, **15** [2], 183–88 (1931).—The Devonian black shales of central New York are described. Current theories of black shale deposition are reviewed, and their application to the New York shales is discussed. The conclusion is reached that the type of decomposition rather than the type of organic materials determines the bituminous content of these shales and that this particular type of decay existed only where the water was truly saline and toxic conditions were present. Comparatively shallow water seems to have been the environment of deposition. G.M.H.

Sub-Trenton formations in Ohio. ISABEL B. WASSON. *Jour. Geology*, **40** [8], 673–87 (1932).—A test hole with total depth of 4746 ft., located near the axis of the Cincinnati arch in Ohio, has revealed several new formations which are either Middle or Lower Cambrian or Pre-Cambrian in age. Below the lower magnesian dolomite and Upper Cambrian sandstones are 100 ft. of red sands and shales tentatively correlated with the "red clastic series" of Minnesota. Then follow 400 ft. of arkose and dolomite, never previously found in this region, which are possibly Keweenawan. Below this the test penetrated over 800 ft. of black, carbonaceous limestone which is considered to be Pre-Cambrian. G.R.S.

Collophane from Miocene brown shales of California. E. WAYNE GALLIHER. *Bull. Amer. Assn. Petroleum Geol.*, **15** [3], 257–70 (1931).—Pyritized collophane oölites from the Calif. Miocene and the matrix in which they occur are described. Certain phases of their origin are discussed. G.M.H.

Yeager clay, south Texas. JULIA GARDNER AND A. C. TROWBRIDGE. *Bull. Amer. Assn. Petroleum Geol.*, **15** [4], 470 (1931).—This clay, overlying the Fayette sandstone, is briefly described. G.M.H.

Clays of southeast England. H. G. DINES. *Brit. Clayworker*, **41** [487], 265–68 (1932).—The relative importance of the various geological formations as brick producers is given. *Ibid.*, **41** [488], 303–309 (1932).—Various clay beds are discussed in detail. R.A.H.

BOOKS AND BULLETINS

Dana's Textbook of Mineralogy. E. S. DANA. 4th ed. by W. E. Ford. John Wiley & Sons, New York. 851 pp. Price $5.50. *Mining & Met.*, **14** [313], 11 (1933).—Essential changes include (1) sections on crystal structure and its investigation by means of X-rays and the origin, mode of occurrence, and association of minerals, and (2) a thorough revision of the section on descriptive mineralogy. E.J.V.

Handbook of Mineral Chemistry. (Handbuch der Mineralchemie.) Edited by C. DOELTER AND H. LEITMEIER. Theodor Steinkopff, Dresden and Leipzig, 1930. Reviewed in *Mineralog. petrog. Mitt.*, **41** [1], 103–104 (1931); see also *Ceram. Abs.*, **9** [11], 989 (1930). G.R.S.

Practical Geology. (Geologia pratica.) E. CORTESE. Ulrico Hoepli, Milan, 1932. 447 pp. 20L. Reviewed in *Chim. & ind.*, **28** [6], 1337 (1932).—The book is a geological study of Italy and reviews different building materials (limestone, clay, sand, pozzuolana, etc.), metallic minerals, and lithoids (bauxite, kaolin, feldspar, etc.). M.V.K.

Occurrence of the Chemical Elements in the Earth. GEORG BERG. *Z. Ver. deut. Ing.*, **76** [37], 900 (1932); *Chim. & ind.*, **28** [6], 1337 (1932); for abstract see *Ceram. Abs.*, **12** [1], 34 (1933).

Mineral Resources of the United States in 1931. O. E. KIESSLING AND M. B. CLARK. This is a summary of separate chapters published throughout the year by the Bureau of Mines. 110 pp. 10¢. R.A.H.

Feldspar in 1931. H. H. HUGHES AND JEFFERSON MIDDLETON. Bur. Mines *Mineral Resources U. S.* 12 pp. 5¢ from Supt. of Documents, Govt. Printing Office, Washington, D. C. R.A.H.

Silica in 1931. E. R. PHILLIPS. Bur. Mines *Mineral Resources U. S.* 6 pp. 5¢ from Supt. of Documents, Govt. Printing Office, Washington, D. C. R.A.H.

Fifty-third annual report of the director of the Geological Survey for the fiscal year ended June 30, 1932. WALTER CURRAN MENDENHALL, director. 94 pp. 10¢ from Supt. of Documents, Govt. Printing Office, Washington, D. C. R.A.H.

Summary of information on the state geological surveys and the United States Geological Survey. Compiled by M. M. LEIGHTON. *Bull. Nat. Research Council*, No. 88 (1932).—Scope of activities, organization, appropriation, publications, accomplishments, and present main lines of work are briefly summarized for the geological survey of each state and for the U. S. Geological Survey. J.L.G.

Geophysical Abstracts. No. 42. F. W. LEE. Bur. Mines *Periodical Service Report G. A.* 42. Price 10¢. For No. 41 see *Ceram. Abs.*, **12** [1], 34 (1933). R.A.H.

Economics of potash recovery from wyomingite and alunite. J. R. THOENEN. Bur. Mines *Rept. of Invest.*, No. 3190. 78 pp. Free. This report contains data from a field survey of deposits in regard to accessibility for exploitation, probable location of treatment plants, source and costs of raw materials, and probable markets for products from wyomingite and alunite. It also gives information obtained from the study of patents concerning operating costs and processes having attractive financial possibilities. R.A.H.

Report of the Committee on Sedimentation, 1930–1932. ANON. *Bull. Nat. Research Council*, No. 89 (1932).—The report is divided into 22 sections. J.L.G.

Chemistry and Physics

Is there a compound Al_2Zn_3? M. v. SCHWARZ AND O. SUMMA. *Metallwirtschaft*, **11**, 369–71 (1932).—Other investigators using micrographic and thermoanalytical methods have claimed that the compound Al_2Zn_3, containing Al 21.3 and Zn 78.7%, exists. However, the reported concentration and temperature zones differ. The authors found that alloys containing 10 to 50% Al with and without small Mg and Cd

additions have a definite arrest in their heating curves at 290°. The cooling curves indicate the decomposition of β- into α- and γ-phases. A wire containing Al 21.3, Mg 0.1, and Zn 78.6% was examined by X-rays. The Debye diagram indicated a hexagonal arrangement similar to pure Zn, but the strongest Al lines were also visible. When heated to 350° for 60 min. and quenched in ice water the wire had a face-centered cubic lattice with a 3.978Å lattice constant while that of pure Al is 4.043Å. An alloy of 25% Zn and 75% Al, which is beyond the limits of the γ-solid solution, heat-treated in the same way had a lattice constant of 4.030Å, and a 50% Zn alloy had almost the same constant. The constants of the β-phase and the γ-solid solution can easily be distinguished. After aging of the quenched 21.3% Al alloy at room temperature it gradually assumes a hexagonal arrangement while the intensity of the cubic lattice becomes less. This change is hastened by heating up to 350° and cooling slowly. The β-phase decomposes. Calculating from the specific gravity, the molecular weight, and the lattice constant, the compound Al_2Zn_3 would have 0.79 molecule per lattice cell, a considerable deviation from a whole number. If a substitution solid solution is assumed the result is 3.96 or practically 4. Conclusions: There are two electron arrangements. In one the valence electron is attached to the nucleus and the atom becomes elliptical and leans toward a hexagonal arrangement. In the other the valence electron is loosely connected with the nucleus and the atom is spherical and leans toward a cubic arrangement. The proportion of the two kinds of electron arrangements depends on the temperature and the development of the hexagonal or the cubic symmetry takes time. This also explains the great instability of the β-phase at low temperatures. (*C.A.*)

Investigating clays according to the dissociation method. D. C. Savriev. *Zhur. Prikladnoi Khim.*, **5** [6–7], 753–60 (1932).—A definite composition of kaolinite and water dissociates at a vapor pressure of 1 atmosphere and a temperature of 550°, whereby exactly 1 water molecule is liberated. The remaining water forms a solid solution with kaolinite and is gradually set free during a larger temperature interval (470 to 550°). The results obtained confirm the theory of V. I. Vernadski that in ordinary clays one molecule is constitutional while the other is hydrated or one forms a definite compound while the other forms a solid solution. Two water molecules do not exist, therefore, in ordinary clays. M.V.K.

X-ray studies on the hydrous oxides. I. Alumina. H. B. Weiser and W. O. Milligan. *Jour. Phys. Chem.*, **36** [12], 3010–29 (1932).—X-ray diffraction studies were made on aluminas precipitated under widely varying conditions in order to determine what definite hydrates of alumina exist. Results indicate that there are but two alumina hydrates, (1) gibbsite, $Al_2O_3{\cdot}3H_2O$, both natural and artificial, and (2) diaspore, $Al_2O_3{\cdot}H_2O$. Precipitated alumina aged at 100° was found by X-ray methods to be a new form of alumina, δ-Al_2O_3, with adsorbed water. The product formed by the thermal dehydration of gibbsite below 250°C is δ-Al_2O_3. The existence of ζ-Al_2O_3, recently announced by Barlett (*Ceram. Abs.*, **11** [8], 468 (1932)), was confirmed. The various transformations of precipitated alumina are tabulated in a diagram. **II. Stannic oxide.** *Ibid.*, pp. 3030–38.—X-radiograms show that no definite hydrates were formed. **III. Stannous oxide.** *Ibid.*, pp. 3039–45.—Stannous oxide was found to exist in two polymorphic forms (1) α-SnO which is blue-black in large crystals and brownish green when powdered, and (2) β-SnO which is grayish green. The transition temperature from the α to the β form is approximately 550°C. The crystal structure of α-SnO is tetragonal, of the PbO type, with $a_0 = 3.78$Å and $c_0 = 4.79$Å. Stannous oxide hemihydrate is dehydrated into α-SnO by (1) the action of excess alkali, (2) the action of light, and (3) heating to temperatures above 120° and below 550°. G.R.S.

The system, CaO–$2CaO{\cdot}SiO_2$–CaF_2, and alite. Ernst Jänecke. *Zement*, **21** [26], 377–79 (1932).—Attempts made to represent the system, CaO–$2CaO{\cdot}SiO_2$–CaF_2, to find out whether $3CaO{\cdot}SiO_2$ exists as a compound have been unsuccessful. A new explanation of the formation of mixed crystals of the ternary system, CaO–SiO_2–Al_2O_3, is given. These are represented as mixed crystals according to $2CaO{\cdot}SiO_2$, and instead of the group Si Si, the group Al Ca Al appears. The relationship of these mixed crystals to alite is discussed. M.V.K.

Crystal chemistry of the silicates. F. Machatschki. *Angew. Chem.*, **45** [42], 664–65 (1932); for abstract see *Ceram. Abs.*, **10** [5], 383 (1931). L.T.B.

Test for traces of alkaline metals. R. Bossuet. *Bull. soc. chim.*, **51–52**, 681 (1932); abstracted in *Giorn. chim. ind. applicata*, **14** [10], 499 (1932).—The following method of A. de Gramont for the qualitative determination of traces of alkaline metals was perfected by B. A small stick of pyrophosphate of magnesia is dipped first into the alkaline metal solution to be examined and then held in the flame of an oxyacetylene

torch and observed spectroscopically. The sensitivity of the method is $^1/_2$ mg. for lithium and $^1/_{60}$ mg. for cæsium. M.V.K.

Using the possibilities of the emanation method. F. STRASSMANN. *Naturwissenschaften*, **19** [23–25], 502–504 (1931); *Glastech. Ber.*, **10** [4], 227 (1932).—O. Hahn has given a method for studying the surfaces of fine materials by means of emanation of radioactive materials. By this method a whole series of molecular-chemical problems may be studied. Such problems include the outer surfaces of the grains, the crystal formation, structure of molecules in glasses, water content, and change of molecular configuration on heating. In this paper studies are reported on the surface conditions of materials which have a relatively small surface, including salts and glasses. The specific reports are on (1) the emanation from $BaSO_4$ crystals as it depends on temperature, and (2) the emanation of barium glasses as it depends on temperature. The emanation from glass particles increases with temperature. After several days of heating the emanation decreases and later increases again. L.T.B.

Calibration method for precise determination of lattice constants of polycrystalline material. F. REGLER. *Physik. Z.*, **32** [9], 680–87 (1931); abstracted in *Metals & Alloys*, **3** [9], 266 (1932).—Deviations from the true value of space lattice constants were noticed on polycrystalline material investigated by the Debye-Scherrer-Hull method. In spite of taking into account the Harding correction, increasing values of space lattice constants were measured with increasing reflection angles and with constant dimensions of the sample, and a steady increase of the mean value of the space lattice constants was obtained with increasing sizes of 2 g. of the sample. E.P.R.

Preliminary report on a new method of X-ray powder diffraction. T. M. HAHN. *Phys. Rev.*, **37**, 475 (1931); abstracted in *Metals & Alloys*, **3** [9], 268 (1932).—A preliminary report is given on a method employing the use of a conical beam of X-rays incident upon powdered crystals arranged in circular form about the central axis of the cone normal to the axis. All rays diffracted through an angle, θ, will be brought together at a common point on the axis of the cone. A photographic film along this axis receives the record of the diffraction pattern from which the spacing of the planes of the crystal may be determined. Advantages of this method are reduced time of exposure and an increased separation of diffraction spots. E.P.R.

Equilibrium studies in systems containing magnesium oxide, iron oxide, and magnesium aluminate. HENRY G. FISK AND WM. J. MCCAUGHEY. Ohio State Univ. *Eng. Expt. Sta. Bull.*, No. 70, pp. 1–44 (1932).—Fe oxide passes into solid solution in periclase at high temperatures, probably as $MgO{\cdot}Fe_2O_3$ with Fe_3O_4. Such oxide is thrown out of solid solution or selectively precipitated by slow cooling almost at once as magnesioferrite. At high temperatures periclase takes large amounts of FeO and Fe_2O_3 into solid solution in varying ratios, depending upon composition and temperature. In mixtures of periclase and Fe oxide containing less than 10% of Fe oxide, FeO is in excess of that required to form magnetite. When large amounts of Fe oxide are in solid solution MgO appears to lower the O pressure of Fe_2O_3 considerably. Magnetite forms at high temperatures. A continuous series of solid solutions is formed with spinel. Spinel will retain up to 50% of Fe_3O_4 in solid solution at room temperature. Above this the Fe oxide is precipitated as hematite. Spinel and magnesioferrite are isomorphous, forming solid solutions with each other without formation of intermediate compounds. (*C.A.*)

Temperature-viscosity relations in the system, CaO–SiO_2–CaF_2. C. H. HERTY, JR., F. A. HARTGEN, AND G. T. JONES. Mining Met. Invest., Bur. Mines, Carnegie Inst. Tech., Mining Met. Advisory Boards, *Coöp. Bull.*, **56**, 1–31 (1931).—The viscometer used embodies, with several refinements, that previously described (*Ceram. Abs.*, **10** [2], 146 (1931)). The viscosities of 36 slags were measured over the temperature range, 1000 to 16,000°. The results are presented in a series of composition-viscosity isotherms. In general, the viscosities are low and they continually decrease as one proceeds from the binary CaO–SiO_2 to the apex representing 100% CaF_2, the greatest change in viscosity being in the neighborhood of 5 to 10% CaF_2. A brief review is given of the literature on slag viscosity measurements. A bibliography of 16 references is also included. (*C.A.*)

Thermal dissociation of gypsum in the presence of catalyzers. I. E. ADADUROV AND W. P. PLIGUNOV. *Zhur. Prikladnoi Khim.*, **5** [2], 149–56 (1932).—The small influence of SiO_2 on the composition, $CaO{\cdot}SO_3$, shows that no ordinary reaction of substitution of the sulfuric anhydride by SiO_2 occurs, but a secondary reaction appears after the primary process of the thermal decomposition of gypsum. The lack of additivity of influences on the decomposition of additions of Al_2O_3, Fe_2O_3, Cr_2O_3, etc., shows that the reaction of the formation of silicates, aluminates, ferrites, etc., is a secondary reac-

tion while the decomposition of $CaSO_4$ appears as a primary reaction. These data show that it is not a simple chemism but a catalyzed process of thermal dissociation of gypsum by additions. Cr_2O_3 is the most effective catalyzer among those studied. M.V.K.

Thermal dissociation of chemically pure gypsum in the presence of catalyzers. I. E. ADADUROV, L. GALAMEJEVA, AND D. V. GERNET. *Zhur. Prikladnoi Khim.*, **5** [6–7], 736–43 (1932).—The decomposition of chemically pure gypsum is conditioned up to 900° by the thermal mobility of the lattice elements. Because of the transformation of silica into tridymite which promotes the reaction, $2CaO + SiO_2 \longrightarrow Ca_2SiO_4$, the velocity of dissociation increases strongly over 900°. The admixtures of Al_2O_3, Fe_2O_3, and Cr_2O_3 cause a loosening up and the destruction of the bonds in the molecule $CaSO_4$ long before the temperature is reached at which the reaction of formation of aluminates, ferrites, and chromates of calcium usually takes place. The addition of Fe_2O_3 to a mixture of the composition, $2CaSO_4 + SiO_2$, reduces the transformation percentage explained by the formation of ferrosilicates. The results obtained show that the catalyzed thermal dissociation of $CaSO_4$ is a primary process and the formation of calcium silicate is a secondary process which promotes the course of the thermal dissociation of gypsum. M.V.K.

Nature of coagulation viscosity and thixotropy in colloidal systems. S. S. KISTLER. *Jour. Phys. Chem.*, **36** [12], 2949–66 (1932).—The existence of cybotactic complexes in liquids is discussed. Colloids may be divided into two classes depending upon whether the surfaces tend to depress or stimulate the formation of cybotactic complexes. Differences between ease of dispersion of lyophile and lyophobe colloids and the unexpected large rate of diffusion of the former are explained. An explanation of the lyotropic series, $Li^+ \longrightarrow Na^+ \longrightarrow K^+ \longrightarrow NH_4^+$, is given. The influence of a colloid on the viscosity of a liquid is ascribed to three separate effects. Thixotropy is given a rational explanation. G.R.S.

Contribution to the study of the flow of viscous liquids. C. CAMICHEL. *Jour. Rheol.*, **3** [4], 413–14 (1932).—An introduction is given to the following 9 papers: **I. Flow of a viscous liquid about an obstacle. Curves α, β. Alternating vortices of Bénard-Karman.** C. CAMICHEL AND P. DUPIN. *Ibid.*, pp. 415–19. **II. Various modes of flow at the entrance of a nozzle.** C. CAMICHEL AND P. DUPIN. *Ibid.*, pp. 420–22. **III. Secondary vortices produced in the stream of an obstacle immersed in a liquid.** E. CRAUSSE AND J. BAUBIAC. *Ibid.*, pp. 422–24. **IV. Limiting layer upon stream of a plate parallel to the current.** L. ESCANDE AND M. TEISSIE SOLIER. *Ibid.*, pp. 425–26. **V. Surface of discontinuity produced by a plate normal to the current.** L. ESCANDE AND M. TEISSIE SOLIER. *Ibid.*, pp. 426–29. **VI. Distribution of pressure around a cylinder immersed in water and coefficient of unit resistance for Reynolds numbers between 500 and 3000.** E. CRAUSSE AND J. BAUBIAC. *Ibid.*, pp. 429–32. **VII. Determination of the vorticity at a given point for different values of the Reynolds number.** C. CAMICHEL AND P. DUPIN. *Ibid.*, pp. 432–33. **VIII. Anomalies exhibited by colloids for low Reynolds numbers.** M. PICHOT AND P. DUPIN. *Ibid.*, pp. 434–35. **IX. Remarks on the viscosity of a liquid in which solid particles are held in suspension.** J. LHOMME. *Ibid.*, pp. 435–36. G.R.S.

Thermal investigation of artificial aluminum silicates. YU. K. DELIMARSKII. *Ukrain. Khem. Zhur.*, **6**, 175–85 (1932).—Al_2O_3 prepared by heating the nitrate shows an exothermic transformation. Precipitated Al_2O_3 does not show this effect. SiO_2 preparations show no transformation at 900 to 1000°, nor does a mixture of Al_2O_3 and SiO_2. Al silicates obtained by reaction of the oxides in alkaline solutions show an exothermal effect at 900 to 1000°. (*C.A.*)

Interference method of measuring thermal expansion. GEORGE E. MERRITT. Bur. Stand. *Jour. Research*, **10** [1], 59–76 (1933).—This paper is in response to numerous inquiries for details of the method developed at the Bureau and described in *Scientific Papers* Nos. 393 and 485 and several articles in outside publications. It is intended as a manual for the use of those who wish to measure thermal expansions by the interferometric method. As such, a more complete description of the apparatus and methods developed can be included than would be in order in a paper dealing primarily with the results of a particular set of measurements. The apparatus, method of making specimens, forms for taking data, and computation of data are each the subject of a careful exposition. An appendix contains tables and special calculations. R.A.H.

X-ray diffraction patterns show strain in metals. N. P. GOSS. *Metal Progress*, **22** [5], 48–51 (1932).—X-ray studies have given a vivid picture of the arrangement of the atoms in crystals of pure metals, solid solutions, and chemical compounds. The disposition of the atoms within the crystals is known with exactness. The article,

although applied directly to strain in metals, also gives a brief discussion of the general usefulness of the X-ray. E.P.R.

Rapid method of determining the specific gravity of pigments and powders. E. J. DUNN, JR. *Proc. A.S.T.M.*, **32** [Part II], 659–65 (1932).—This paper describes a method of determining the specific gravity of pigments and powders based on the wetting of the particles by utilizing a dispersing agent and grinding with a mortar and pestle. This is an effective way of breaking down agglomeration and eliminating occluded air which are the main difficulties in the specific gravity test for powders. Some experimental results are reported. R.A.H.

Determining fluorine in apatites, phosphorites, and superphosphates. I. TANANAEV. *Zhur. Prikladnoi Khim.*, **5** [6–7], 834–42 (1932).—A new method for determining fluorine consists in distilling fluorine in the form of H_2SiF_6 in glass apparatus. The method can be utilized for the quantitative determination of fluorine in insoluble fluorides and phosphate materials. Phenol red is a suitable indicator for determining the end of titration of silicon fluoride according to Schucht and Möller. M.V.K.

Volumetric-analytical determination of calcium fluoride. I. TANANAEV. *Zhur. Prikladnoi Khim.*, **5** [3–4], 445–47 (1932).—The difficultly soluble CaF_2 dissolves easily under the action of $AlCl_3$, whereby calcium cryolite is formed. The fluorine ion combines with the aluminum into a complex ion and does not prevent the precipitation of calcium in the form of CaC_2O_4. With this property, the reaction between CaF_2 and $AlCl_3$ can be used for the quantitative determination of CaF_2 in preparations and in fluorspars. The procedure is as follows: The weighed substance, CaF_2, is heated and dissolved in $AlCl_3$ with additions of tartaric and oxalic acid (per 1 to 2 g.); after neutralizing with ammoniac the precipitate, CaC_2O_4, is titrated with $KMnO_4$ after dissolving in H_2SO_4. The accuracy of the determination fluctuates between 0.1 and 0.3%, and takes about $1^1/_2$ hours. M.V.K.

Analytico-volumetric determination of alkali sulfates. I. FIALKOV AND M. SCHIGOL. *Zhur. Prikladnoi Khim.*, **5** [6–7], 849–52 (1932).—The volumetric-analytical method of Klemm (*Z. anal. Chem.*, **9**, 122 (1870)) has been modified by the authors. The barium chloride surplus is precipitated in a warm solution by a mixture of 0.1 normal NaOH and 0.1 normal Na_2O_2. The accuracy of the method is considerably increased. M.V.K.

Separation and determination of traces of lead. J. H. HAMENCE. *Analyst*, **57**, 622–26 (1932).—The colorimetric determination of Pb being interfered with by Fe, a separation of Pb and Fe as thiocyanates is based on the fact that $Pb(SCN)_2$ is not soluble in a mixture of equal volumes of ether and amyl alcohol, and $Fe(SCN)_3$ is very soluble. H.H.S.

Preparing cuprous chloride solution for gas analysis. R. E. SUMMERS. *Power*, **75** [2], 55 (1932).—A direct and rapid procedure for the preparation of cuprous chloride for gas analysis with the Orsat type of apparatus is described. F.G.H.

Evaporation. A. WAGNER. *Gerlands Beitr. Geophys.*, **34**, *Köppen Band*, **3**, 85–100 (1931); *Sci. Abs.*, **35A**, 289 (1932).—Previous results are contradictory. The problem consists of (*a*) emergence of vapor molecules from the water surface; (*b*) passage through the limiting layer by diffusion; and (*c*) removal of diffused vapor by mass exchange. From results deduced for diffusion of heat, the velocity of evaporation is given by the expression $10^{-2}(e_0-e_1)\sqrt{u+0.3}\cdot f_2(b)\cdot f_3(T)$ g./sq. cm./hr., where e_0 is the vapor pressure at the evaporating surface, e_1 that in the air, u the wind velocity, e_1 and u being measured close to the surface of the earth, b the air pressure, and T the absolute temperature. Provided that $u \gtrsim 4$ m./sec., and the height $\gtrsim 3$ km., $f_2(b)$ approximately $= b_0/b$, and $f_3(T) = T/T_0$, b_0, T_0 being pressure and absolute temperature at the height concerned. The method is applied to calculate the evaporation from a snow surface. (*C.A.*)

Data. XII. T. W. GARVE. *Clay-Worker*, **98** [6], 232–33 (1932).—After defining internal and external thermal conduction, G. explains conductivity and conductance, listing substances as good conductors, poor conductors, and insulators according to their specific conductivities. Conductances of various solid substances are also listed. For Part XI see *Ceram. Abs.*, **12** [1], 31 (1933). E.J.V.

BOOKS

Science in Action. E. R. WEIDLEIN AND W. A. HAMOR. McGraw-Hill Book Co., Inc. 310 pp. Reviewed in *Foundry*, **60** [9], 50 (1932).—The growth of industry through the application of industrial research is portrayed. Engineers, scientists, and business men are given a comprehensive picture of the place of science in industry, the

need and methods of industrial research, results achieved by various organizations, and important factors in research procedure. F.G.H.

Beryllium and Its Alloys. ANON. Issued by the Central Committee on Scientific and Engineering Research of the Siemens Co. Published by the Chemical Catalog Co., Inc. 331 pp. Reviewed in *Foundry*, **60** [12], 46 (1932).—Many valuable illustrations are included in this work which undoubtedly is the most complete collection of information thus far presented on the subject. F.G.H.

Elementary Chemical Theory and Calculations. J. KNOX. 138 pp. 3rd ed. Gurney and Jackson, London, 1932. Reviewed in *Chem. & Ind.*, **51** [44], 888 (1932).—About 300 problems (with answers) and about 80 worked examples are given. Much theoretical discussion on clear and simple lines accompanies the examples. G.R.S.

Applied Colloid Chemistry. W. D. BANCROFT. *Mining & Met.*, **14** [313], 11 (1933); see also *Ceram. Abs.*, **12** [2], 84 (1933). E.J.V.

Results of Applied Physical Chemistry. Edited by M. LE BLANC. Reviewed in *Chem. & Ind.*, **51** [44], 889–90 (1932); for abstract see *Ceram. Abs.*, **11** [8], 473 (1932). G.R.S.

PATENTS

Separation of titanium dioxide hydrate from hydrolyzable solutions of titanium salts. J. BLUMENFELD. Brit. 384,875, Dec. 21, 1932.

Preparation of beryllium compounds. DEUTSCHE GOLD- UND SILBER-SCHEIDEANSTALT VORM. ROESSLER. Brit. 384,926, Dec. 21, 1932.

Anhydrous borax (sodium tetraborate) process and apparatus for making it. F. B. DEHN (American Potash & Chemical Corp.). Brit. 385,217, Dec. 28, 1932.

Production of antimonates of the alkali and alkaline earth metals. I. G. FARBENINDUSTRIE AKT.-GES. Brit. 385,218, Dec. 28, 1932.

General

Uses for sodium aluminate. J. A. HOLMES. *Power*, **75** [7], 241–42 (1932).—By coagulating suspended solids or sludge in the boiler, sodium aluminate prevents scaling and foaming. Data from typical plants illustrate the possibilities. F.G.H.

Flotation of kaolin, a contribution to flotation of oxides. O. SUMMER. *Feuerfest*, **8** [9], 140 (1932); for abstract see *Ceram. Abs.*, **11** [12], 641 (1932). M.V.K.

Solubility of water in mineral oils. A. E. FLOWERS AND M. A. DIETRICH. *Power*, **75** [7], 232–34 (1932).—Water determinations on samples of oil taken in the field show that even at relatively low temperatures oils may contain appreciable quantities of dissolved water, the amount being dependent to a considerable degree upon the relative humidity of the air. Tables and graphs are included. F.G.H.

Furnace fired with powdered coal. F. S. O'NEIL. *Foundry*, **60** [10], 18–50 (1932).—Cleanliness of plant and economy of operation are features of furnace firing with powdered coal. The coal-crushing and pulverizing operations and automatic feeding of coal under pressure to the furnaces are described in detail. Illustrated. F.G.H.

Electricity in modern manufacture. E. G. GUERRÉE. *Rev. mat. constr. trav. pub.*, No. 277, pp. 181–86*B* (1932).—G. discusses electrical installations used for manufacturing refractory mixes. M.V.K.

Penetration of water in ceramic bodies and its measurement at different temperatures. J. ANDRÉ LAVERGNE. *Rev. mat. constr. trav. pub.*, No. 278, pp. 201–206*B* (1932).—The results of tests are explained with tables and diagrams. M.V.K.

Measuring and recording instruments for the brick industry. B. HELAN. *Stavivo*, p. 484 (1931).—The Society for the Encouragement of the Brick Industry in Czechoslovakia has bought recording and measuring instruments for kilns and driers and lends them to members. Under the supervision of the Heat Economy Department of the Czechoslovakian Ceramic Society, inexperienced men are able to take records and use the apparatus. 11 figures. R.B.

Deterioration of domestic chimneys. II. J. E. MACONACHIE. *Can. Chem. Met.*, **16** [12], 292–95 (1932).—Asphalt and chromate emulsion protective coating proved to be superior. It can not be definitely stated how long this adequate protection by one coating will last. Illustrated. For Part I see *Ceram. Abs.*, **12** [2], 61 (1933). E.J.V.

Terms concerning aging. R. BARTÁ. *Zprávy Československ. keram. společnosti*, **8** [2],

152–53 (1931); abstracted in *Sprechsaal*, **65** [21], 390 (1932).—New terms are introduced to describe aging abilities of clays. Aging is valued in terms of tensile strength. Clays are differentiated according to the rate of improvement from aging. M.V.K.

Clay. H. E. NOLD. *Mining & Met.*, **14** [313], 52 (1933).—A brief summary of progress made in newly developed processes for working clay and in beneficiating clays in 1932 is presented. E.J.V.

Practical clayworking. ANON. *Brit. Clayworker*, **41** [487], 256–58 (1932).—The mixer, high-speed rollers, clay-preparing train of machines, preparation of dry clay or shale for plastic making, preparation of clay or shale for stiff plastic manufacture, sand, shape of particles and grading, and grog and its preparation and uses are discussed. R.A.H.

Mechanism of drying of clays. T. K. SHERWOOD AND E. W. COMINGS. American Institute of Chemical Engineers [Preprint], Dec., 1932.—This paper presents the results of experimental studies on the rate of drying of clay bodies. The drying process is divided into (1) a constant-rate period during which the moisture evaporates from a continuous film of water on the solid surface and the rate is governed by the air velocity, air temperature, humidity, and other drying conditions, and (2), after a "critical" moisture content is reached, a falling-rate period during which the mechanism of drying is frequently complicated, but internal diffusion of moisture through the solid becomes controlling at some point before the solid is in equilibrium with the air at the existing humidity. These factors indicate the desirability of a change in drying conditions with decreasing moisture content. The critical moisture for plastic clay (mixture of 60% plastic and 40% flint) was approximately 19%; for flint clay (65% flint, 15% plastic, and 20% calcined clay) 13%; and for silica brick 9 to 10% in one test and 5 to 6% in another. For plastic clays in general the critical point approximates the point at which shrinkage is approximately complete, so that injury to the material by too rapid drying is apt to take place only in the constant-rate period when surface evaporation is controlling. W.E.R.

Mechanical mining of clay. K. PEUSTEL. *Borhammer*, No. 4; abstracted in *Rev. mat. constr. trav. pub.*, No. 276, pp. 175–76*B* (1932).—New types of apparatus and devices used for mining clay and kaolin are described. M.V.K.

Handling of materials. J. B. FORKER. *Foundry*, **60** [8], 65–66 (1932).—F. outlines the following nine rules to observe in planning handling systems: (1) Keep the method as simple as possible. (2) Use standardized equipment built by responsible manufacturers. (3) Avoid multihandling. Pick up the load where it is, take it to its destination, and then set it down. (4) Have an alternative plan for handling that can be used when the main system is out for repairs. (5) Determine an economical load or amount to handle at one time. (6) Do not back track, but keep the flow of material in one general direction and the distance traversed at a minimum. (7) Select the type of equipment which will be most flexible and economical for the demand which will be made on it. (8) Plan for periodical inspection and maintenance. (9) Purchase materials-handling machinery for savings, not initial investment. F.G.H.

Use of explosives in quarries. V. PELANT. *Stavivo*, p. 253 (1932).—In Czechoslovakia the following explosives are used for quarrying: (1) gun powder TN; (2) explosives of the ammonium nitrate class, dynamone J and dynamone JS, which contain 2% more nitrotoluol and wheaten flour instead of wood flour; (3) explosives of the nitroglycerine class, dynamite I containing 65%, dynamite II containing 46%, and dynamite III for the winter containing 29% of nitroglycerine. The lower the brisance of the explosive used, the better the boreholes must be rammed. R.B.

Better distribution of explosive charge. R. J. BRODHEAD. *Explosives Eng.*, **10** [1], 22–23 (1932).—B. discusses variation and type of strata, hardness of rock, prevalence of water, size of quarry, height of face, and other factors which must be considered in determining the best method of blasting and the correct type of explosive to use. F.G.H.

Lawsuits based on alleged silicosis. ANON. *Foundry*, **60** [12], 23–56 (1932).—Methods employed by unscrupulous lawyers and doctors in common law damage cases based on alleged silicosis are described in detail. To prevent the burdening of industry with unfair claims, it is recommended that silicosis and kindred sicknesses be taken out of common law and be placed clearly under the jurisdiction of the workmen's compensation acts. F.G.H.

Elimination of silicosis. ANON. *Pottery & Glass Rec.*, **13** [5], 149 (1931).—It was found that the utilization of bone ash instead of flint powder when setting porcelain considerably diminished the danger of silicosis. Bones which when calcined contain a large percentage of fat, produce a much better material than those which are cleaned

chemically before firing. The hard parts of bones are better than the porous jointing bones. M.V.K.

Zoned air control for stokers made automatic. F. J. CHATEL. *Power*, **75** [4], 121–24 (1932).—Individualized windboxes with individual control of air flow for the distribution of air to each retort of underfeed stokers are discussed. Illustrated. F.G.H.

Trends in the design and operation of large underfeed stokers. ANON. *Power*, **75** [12], 450–51 (1932).—Indications are that future furnaces may be designed to fit the stoker, rather than the reverse. Major operating limits are clinkering and blowing the coal off the grates. Maintenance cost varies between 3¢ and 20¢ per ton of coal burned. F.G.H.

Efficient operating and banking methods with overfeed stokers. H. M. SPRING. *Power*, **75** [20], 719 (1932). F.G.H.

Types of steam turbines and their application. G. R. PROBST. *Power*, **75** [17], 614–17 (1932).—The various types of turbines available and the conditions under which they should be applied are described and illustrated. F.G.H.

Calculating steam and power costs in industrial plants. H. J. BYRNE. *Power*, **75** [4], 140–44 (1932).—The costs of power and steam per unit of product are discussed and calculated. Flow sheets and diagrams are included. F.G.H.

Economic lot sizes. G. L. STUDLEY. *Mech. Eng.*, **54** [3], 205–207 (1932).—The derivation and application of a formula for the determination of economic production quantities are presented. Specific examples are described and illustrated with charts. F.G.H.

Wage incentives for the smaller industries. STEWART M. LAWRY. *Better Enameling*, **3** [12], 17 (1932).—L. writes of standardization of methods and procedure, equipment, planning and scheduling, and supervision responsibilities. He explains the wage-incentive plan and illustrates with examples. This system involves measurement of the work, compensation for the work, and control of its application. W.W.M.

1933 New Year's greetings. EDITORIAL. *Bull. Amer. Ceram. Soc.*, **12** [1], 1 (1933).

Rules for presentation of papers at technical sessions of the American Ceramic Society. ANON. *Bull. Amer. Ceram. Soc.*, **12** [1], 26–32 (1933).

Coöperation to revive pottery industry. ANON. *Ceram. Ind.*, **20** [1], 17–21 (1933).—Activities at the U. S. Potters' Assn. annual convention in Washington, D. C., are reported. W.W.M.

Ceramics. R. BARTA. *Národní Listy*, May 1, 1932.—The manufacture and use of products are presented in encyclopedic form. R.B.

Coöperation of technical societies in the improvement of ceramic structural material. JOSEF MATĚJKA. *Stavivo*, p. 393 (1932).—The following organizations are represented in the Czechoslovakian Ceramic Society: Society for Encouragement of the Brick Industry, Ceramic and Refractory Division of the Union of Industrialists, the Keramika, Ltd., the Union of Producers of Glazed Clay Tile, the Union of Employers of Stove Tile and the Pottery Industry, the Union of Porcelain Manufacturers, the Union of Cement Works, and the Union of the Lime Industry. These organizations coöperate with the Czechoslovakian Ceramic Society in the fields of science, standardization, testing of materials, schools, statistics, heat economy, etc. R.B.

Establishment of a ceramic school of technology. JOSEF MATĚJKA. *Stavivo*, p. 502 (1931).—As the result of the endeavors of the Czechoslovakian Ceramic Society, the state brickmakers school was reorganized as a technical school of ceramics, cement, and mortars in 1932. The following divisions are established: (1) brickmaking, (2) stove fitting and pottery, (3) technical stoneware, sewer pipe, refractories, etc., and (4) cement, lime, mortars, etc. R.B.

Report of the activities of the Brno State Research Institute for the Silicate Industry during 1930. O. KALLAUNER. *Stavivo*, p. 519 (1931).—At this institute in 1930, 6 scientific workers, 2 fellows, 3 volunteers, and 2 outside members coöperated in ceramic research. Forty technological and scientific papers were published. The Institute is sponsored by the Czechoslovakian Ceramic Society, the Masaryk Institute of Labor, and the State Dept. for Schools and Public Instruction. R.B.

BOOKS AND BULLETINS

Index to A.S.T.M. standards and tentative standards. ANON. Issued by the American Society for Testing Materials, Philadelphia, Pa., Oct., 1932. R.A.H.

Hoyer-Kreuter Technological Dictionary. (Hoyer-Kreuter Technologisches Worterbuch.) Edited by A. SCHLOMANN. 6th ed., completely revised. **Vol. I. German-**

English-French. 795 pp. **Vol. II. English-German-French.** 767 pp. **Vol. III. French-German-English.** 719 pp. J. Springer, Berlin; Machinery Publishing Co., London, 1932. Reviewed in *Chem. & Ind.*, **51** [44], 903 (1932).—The subjects covered include metallurgy, ceramics, raw and finished materials, testing, chemical technology, and patents. Extensive revisions and additions have been made since the publication of the 5th edition in 1904. G.R.S.

Handbook of Industrial Temperature and Humidity Measurement and Control. M. F. BEHAR. *Mining & Met.*, **13** [312], 533 (1932); *Brick Clay Rec.*, **81** [5], 172 (1932); for review see *Ceram. Abs.*, **12** [2], 88 (1933). E.J.V.

A Decade of Ceramics, 1920–1930. ANON. 284 pp. G. Stiepel, Reichenberg 1930. Reviewed in *Chem. & Ind.*, **51** [52], 1067–68 (1932); for abstract see *Ceram. Abs.*, **11** [3], 214 (1932). G.R.S.

Air conditions and the comfort of workers. METROPOLITAN LIFE INSURANCE CO. *Foundry*, **60** [11], 72 (1932).—This booklet deals with temperature standards for comfort, measurement of physical properties of air, conditioned air, the effect of high atmospheric temperatures on workers, air pressure, and air cleanliness. F.G.H.

Mining Statutes of the State of Pennsylvania. J. A. HUFF AND V. V. BAKER. Bur. Mines *Information Circ.*, No. 6653. 106 pp. Free. The report summarizes laws concerning the operation of anthracite and bituminous coal mines and of oil and gas wells. R.A.H.

Book Review

Josiah Wedgwood. R. BARTA. Books of the Czechoslovakian Ceramic Society, No. 4, 1931. 132 pp. 52 illustrations. A biography, literature, and collections of Josiah Wedgwood are given. The bicentenary celebrations at Stoke-on-Trent are described. The foundation of an international ceramic society is proposed in honor of Wedgwood. Visits to ceramic plants and institutes in England are described.

R. BARTA

PATENTS

Clays. WM. FELDENHEIMER. Fr. 724,526, Dec. 22, 1930. A soluble compound of P is added to a suspension of clay in water after bleaching to prevent the clay from becoming colored again during drying. (*C.A.*)

Ceramic materials. DEUTSCHE TON- & STEINZEUG-WERKE A.-G. Fr. 724,575 Oct. 15, 1931. Crude plastic ceramic materials are purified by a treatment with salts such as KCl, preceded or followed by treatment with an acid such as HCl. (*C.A.*)

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of the

AMERICAN CERAMIC SOCIETY

A Monthly Publication Devoted to Proceedings of the Society, Discussions of Plant Problems, Discussions of Technical, Scientific, and Art Questions, and Promotion of Coöperative Research

Edited by the Secretary of the Society Assisted by Officers of the Industrial Divisions

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Vol. 12 **March, 1933** **No. 3**

EDITORIAL

REPORT OF GENERAL SECRETARY ROSS C. PURDY[1]

MR. PRESIDENT AND MEMBERS OF THE AMERICAN CERAMIC SOCIETY:

In the *Bulletin*, during the year, you have had reports of the Society's activities. These need not be repeated. Reports by Divisions, Local Sections, Student Branches, and Committees will reveal the productive activities of the Society. The reports by President Poste reveal the executive activities and the results obtained. Your General Secretary is prompted to confine his report to an analysis of the problems with which we are confronted, and to a forecast of our prospects and obligations.

We are not content with this Society being academic. This Society is technical, as well as academic. This brings an overlap in activities with the ceramic trade associations, a situation which adds strength to both without duplicating efforts. We have made effort to present this idea to the trade associations with the hope that ultimately they will work out with us a federated program. We have proposed several such federations and believe that we are getting nearer our goal. We must, however, have unity of ideals and purposes among ourselves before we can impressively propose any program of federated activities. This was one of the purposes of President Poste's editorial in the December *Bulletin*. The chief concern of this Society has been and must continue to be the purely academic activities. The sciences fundamental to the art of producing the highest quality of ware at the lowest cost must ever be our chief concern.

For several years now this Society has by expositions, by conferences, by lectures,

[1] Presented at the Annual Meeting, AMERICAN CERAMIC SOCIETY, Pittsburgh, Pa., February, 1933 (General Session).

and by writings made effort to develop an American consciousness of the high quality of American-made ceramics. We have also promoted "BUY AMERICAN CERAMICS" with alumni associations, hotels, railroads, and clubs. We are this week making a public "Buy American" appeal.

We have not been unmindful of the fact that our products must deserve recognition and warrant purchasing. To this end we have stressed standardization of raw materials, control of processing, and improvement of product.

Further, we have made attempts to bring a realization on the part of the employer and the employee that the technical ceramist must serve with the sales department the same as he does with the production department. Our technical men must be concerned not only with producing the highest possible quality at the minimum cost under controlled processes, but he must also be active in developing new products and in finding and adapting his products to new uses.

The concern of our members, therefore, in the present-day economic conditions and in the factors relating thereto, is not wholly personal—it is their professional concern. Each of us must strive for a realization of the world's economic condition if we are to make successful our efforts to hold our own now, and to secure the largest possible share of business in the future. Such a knowledge and forecast must be made if we are to soundly and profitably manage our personal, our industrial, or our Society affairs. An analysis of our present and a forecast of our future economic situation and proposals for definite actions will be the burden of this report.

General Economic Factors Involved

The factors which are retarding recovery are, according to Poor, (1) government finances, (2) war debts, (3) loss of export trade, (4) declining commodity prices, (5) liquidation and deflation yet to be made.

The favorable factors are (1) increasing credit, (2) increasing confidence, (3) depletion of manufactured stocks.

Taxes must be reduced. This requires a reduction in governmental expenses. It precludes for the present such socialistic governmental acts as old age pensions and employment insurance.

Liquidation and deflation of assets cause temporary losses only. When inventory values will be reduced to the minimum and our plant values reduced nearer to quick sales possibilities, in other words, when our assets are more liquid, recovery to better business will be hastened.

Price levels will not rise for a long while. For this reason the Farm Board has only slight hopes of recovering the loans which they made. Because price levels will continue low, we must absorb losses on the loans made by the Reconstruction Finance Corporation. Securities of railroads, banks, and various sorts of financial institutions have lost considerable negotiability, most of which will not be recovered. The activities of the Home Loan Banks will result in permanent losses because security values of real estate, industrial stocks, and all else will not for a long while, if ever, recover their values as estimated when these governmental loans were made. Somebody must absorb these losses and, in the future, loans must be made on the present reduced values. This loss absorption must be made by our nation and spread to each of us. The collaterals must be returned to their owners. These owners must not directly or wholly suffer this loss.

The federal government must gradually shift to long-term financing and to conversion at lower interest rates. This will lessen unproductive use of bank funds and give more emphasis to industrial financing.

Government agencies must get closer to a pay-as-you-go basis. Cities, counties, and states should operate strictly on a pay-as-you-go basis. To attain this end, there

must be a reduction in public work until the outstanding bonds will have been paid. This will cause a temporary loss of work for the idle, but the end results will justify the misery cost.

To go into debt so deeply that the interest charges constitute a burden is as illogical for our governmental agencies as it is for individual citizens. We have had flagrant inflation of commodity values and of ideas as to our capacities to pay. These must be deflated in terms of the gold dollar. It would be ruinous to attempt this by currency inflation. This would again inflate commodity values and also our falsely supposed abilities to pay and thus greatly prolong the economic depression.

General depreciation of currency by other countries leaves the United States in an insular export position while our tariff valuations in these same depreciated currencies make the United States an open market for imports which undersell our products. Our federal administration is without power to deal with such an emergency. The Tariff Commission can adjust rates, the Customs Bureau can apply dumping regulations, but foreign countries can make appropriate checkmate moves.

Research and Inventions

Our industrial management has not failed. Our labor is skilled. Our machines have increased industrial employment per 1000 men, technocracy to the contrary notwithstanding. Our science, fundamental and applied, is continuing to lighten toil, increase culture, and give more hours for study and recreation, and with it all has increased the opportunities for livelihood in the industries. Applied science has so increased production per acre of farm land, and has so decreased man's labor in tilling the ground, sowing the seeds, gathering the crops, and marketing the products, that thousands of acres are yearly being released for game, park, and forest preserves. We have increased our means of livelihood, culture, and pleasure. Shall we be denied enjoyment of these simply because the wages and cultural opportunities of other countries are far below our standards?

According to the *Wall Street Journal* of December 5, which quotes the *Iron Age* of last year, the census figures show that forty years ago there were sixty-nine industrial employees per 1000 of population. In 1929 there were 72.5 industrial employees per 1000 population. The *American Bankers Association Journal* in a series of articles, is showing data supporting this statement. It is a fact, therefore, that the development of machines of ever-increasing capacities is increasing the number of workers per thousand population. Shall we cease our research and inventions?

Answering our own question, we should steadfastly pursue all educational and research activities so that more people may be gainfully employed, and that all our people, farmers and industrialists, may enjoy the opportunities which our modern inventions have made possible.

Profits and Wages

We must base our budget calculations on commodity prices going lower. We must, however, make a reasonable profit. Stockholders should receive dividends, and executives and workmen must be paid wages commensurate with their fixed obligations to their families and communities.

Excessive profits, salaries, and wages will not be possible for many, many months, if not years. It is a pertinent question if salaries and wages in the higher brackets have not been too high; if they should not be spread to common labor wages.

By the same token, there should be no selling of products below a price that will make the dividends, salaries, and wages needed to finance our stockholders and employees on a thrifty, livable basis.

The Sherman Antitrust Law of 1890 must be replaced by a control act that will

eliminate price cutting and require price fixing. Competition should be on the basis of product quality, delivery service, etc. Our manufacturers, through their respective trade associations, must be permitted to establish rational agreements concerning prices. Unregulated price competition must stop. Price fixing must be on a basis of minimum production and distributing costs compatible with high quality of product, livable income to stockholders, and living wages to the employed.

There must be regulatory laws, but those laws should require manufacturers to organize into associations for fact-finding under governmental regulation.

Importance of Ceramic Trade Associations

The economic depression of the past three years has forced all of us to make beneficial adjustments. Thrift and efficiency for the individual, and a realization that personal advantages and selfish interests are enhanced or depreciated with the welfare of the group are some of the encouraging and uplifting benefits of this economic depression. Individually, we have been forced to manage our affairs and to use our resources on a much more conservative basis. We must realize, however, that self is served best when there is conservation of the well-being of the industrial, social, and political groups of which we are members. We must not forget that individually we are units in a collective scheme of affairs and that we must conserve the well-being of our collective enterprises if we as individuals are to prosper.

Trade associations are more necessary today in our economic scheme than at any previous time. For manufacturing concerns to withdraw support from trade associations, supposedly to conserve their individual resources, is an act which will not only be costly now, but will delay the business revival by which individual firms will recoup their resources. To suppose that the faithful few will carry on and keep their trade association organization and means of service intact during times of depression and have it available when business recovers is a selfish, short-sighted, self-defeating notion. Never were problems of labor, tariff, traffic, and trade more pressing than during these times of business depression.

With increasing competition of nonceramic products and of products imported from countries of depreciated currency, there is a greater need for manufacturers to develop a "share work" program to which each concern will subscribe and faithfully adhere. It is of more economic importance that firms share work than it is for labor to share work. Price cutting turns the wheels that crush rather than save industrial integrity.

Assailed from within by thoughtlessness, selfishness, and inefficiency, and from without by competition of nonceramic and low-valued importation, our ceramic industries are gasping for breath. Your personal welfare and the welfare of the American Ceramic Society are involved. We must work for more faithful support of our trade associations and of this Society if our ceramic companies and our individual selves are to carry through to business stability.

The prices obtained for some of our products have so declined that, under present operating conditions, profits and reasonable wages are impossible. Obviously, such a situation results from unsound thinking, ignorance of costs, poor salesmanship, and a selfishness that blinds our business managers to the benefits of conserving the interest of their collective well-being, their trade association, and this Society.

Imports from Depreciated Currency Countries

The United States Potters Association stated to the Customs Commissioner that due to devaluation of foreign currency, particularly by Japan, our present Smoot-Hawley tariff protection has been nullified. Of the 17,500 pottery workers usually employed, 6500 are without work, and 11,000 are working less than two and one-half days a week.

Pottery production for the first nine months of 1932 was less by $5,186,000 than it

was the first nine months in 1931, and it was $12,827,000 less than it was the first nine months of 1930.

Similar statements were made by several industries. You are familiar through broadcasts and our national magazines with the dwarfing of the electric bulb production.

There is a misconception in the minds of many business men, governmental officials, and congressmen, that these presentations of facts by our industrial groups are attempts to secure higher tariff walls. The facts are that tariff rates and laws need not be changed. What is needed is legislation to make our tariff rates and laws operative in protecting our industries against the disastrous results of depreciated currency of other countries. This is a monetary and not a tariff question.

The following quotation is taken from a report of the Foreign Commerce Department Committee, Chamber of Commerce of the United States:

"Great Britain went off the gold standard in September, 1931, and most of the other instances of currency depreciation followed. Between September 1, 1931, and June 30, 1932, the currencies of 22 countries had depreciated 5% or more. The imports from these countries totaled $393,278,000, representing 52.6% of our total imports for the first half of 1932, namely $747,895,000.

"It is a significant fact, therefore, that over half of the products at present being imported into the United States are benefiting from the advantage of depreciated currencies.

"In a wide variety of smaller manufactured products the competition has become destructive. To quote but a single instance, a manufacturer of Christmas tree lamps reports that in 1931 Japanese manufacturers were selling a particular type of lamp in the United States at prices ranging from 2.3 yen to as low as 2.10 yen per hundred. Japan was then on the gold standard and the landed cost of the lamps ranged from $14 to $16 per thousand. Today Japanese manufacturers are shipping the same article to this country at from 2 yen to 1.80 yen per hundred. The yen today is 22 to 23 cents as against 46.5 cents last year. Thus the landed cost of the lamps this year ranges from $5.50 to $6 per thousand, as against the previous figure of $14 to $16 per thousand.

"Not only has currency depreciation created destructive competition for our manufacturers and producers, but it also has brought loss to the Treasury of the United States since our *ad valorem* duties must be applied not to gold par values but to depreciated currency values. This difference in values amounted to $157,436,000. Under adequate depreciated currency legislation not only would our Treasury Department be richer by a sizable sum in the form of compensating exchange charges, but the Treasury would be richer also by the fact that the present existing *ad valorem* rates of duty would be figured upon a gold par rather than a depreciated currency basis.

"Certain economists and officials have predicted and still maintain that one consequence of depreciation of currency would be a general increase in the wholesale price index of the depreciated currency country, presumably equivalent to the amount of the depreciation. Such argument was brought forward in opposition to legislation to protect American industries against depreciated currency competition. Actual facts, during the period under consideration, prove the falsity of these predictions. Tables compiled for the Committee's use indicate that in no case, except Chile with its new form of government, has there been an increase in the wholesale price index of any one of the depreciated currency countries comparable to the decline in exchange.

"On November 12 of last year the French government took immediate steps to protect its home markets by the establishment of 'provisional compensating exchange surtaxes'; the order putting these into effect was issued by the French President upon recommendation of the French Cabinet.

"Canada, whose currency depreciation was smaller than that of many of her suppliers, particularly the United Kingdom, also took action by the issuance of an Order in Council. Under that Order in Council, for instance, the value of the pound sterling is set at a given figure, at present $4.40, and the difference between that established rate and a 2-week market rate fixed by the Revenue Department is used to estimate a compensating 'dumping' duty, protective of Canadian industries. For levying ordinary duties, par value is used."

Most of the other major countries either had on their statute books, or subsequently placed there, legislative authority to take similar protective action. The United States

stands out prominently as the major world market, on a gold basis, lacking protective legislation against destructive exchange competition.

Bettering Ceramic Industries

Buy American

May "Bettering Ceramic Industries" be the slogan of this Society.

In every way conceived or suggested we have been proposing ways for making Americans ceramically conscious and conscious of the unsurpassed quality of American ware. "BUY AMERICAN" is a patriotic program, the result of which will be employment of American labor, betterment of business, and the giving to each of us a larger purchasing ability.

The slogan "What we can do to make some money" has blinded too many of us to those factors by which money can be made. Money will be made if we can get our factories started, and our factories will start producing when Americans will courageously pay the higher prices for products which make it possible for the American laborer to earn wages sufficient to enjoy the benefits of our modern civilization. The welfare of Americans will be conserved only if our workmen are not placed in competition with the starvation-wage laborers of some of the countries abroad. We must buy only ware that is made by workmen who are paid civilization wages.

Our factories are either idle or at low production, and our employees are idle because of an influx of goods made in countries having low standards of living and debased currency. Tariff, no matter how high it may be, will not correct this situation. *Ad valorem* rates, based on our own currency and scaled to compensate for differences in wages paid, would help, but so also would complete exclusion of such importations.

The ten or less per cent of our products which are exported could, with some advantage, be forgotten if our markets were reserved for products made by laborers who received compensations equal to those paid in American currency and in currency equal to ours in value.

But why wait the slow turn of legislative acts? Why not take this problem as our own individually and BUY AMERICAN ware exclusively.

In the *Outlook* of March 27, 1900, Theodore Roosevelt wrote in part:

"In striving to better our industrial life we must ever keep in mind that, while we can not afford to neglect its material side, we can even less afford to disregard its moral and intellectual side. Each of us is bound to remember that he is in very truth his brother's keeper and that his duty is, with judgment and common sense, to try to help his brother."

The welfare of each of us is dependent on the welfare of our fellowmen. You can not think very studiously without arriving at the logical conclusion that we as individuals can not afford to buy imported ware that is made by low-wage workmen and valued in depreciated currency. Our individual welfare demands that we buy only that ware that is made and sold on American standards of wage and currency.

Samuel G. Blythe in December 3 *Saturday Evening Post* says in part:

"The prosperity of this country depends on the business done in this country. The business done in this country depends on the support of American business, commercial, and manufacturing institutions. If our people buy what we make, every class of our citizenry profits—the workers, the transporters, the distributors, the sellers, the financiers, and the consumers, for our wage payments are billions and without those billions we could not survive an hour. If we do not consume, we can not make. If we do not make, we can not pay our potential makers. If we do not pay our makers, we lapse into bankruptcy, for the real prosperity and progress of this country rest on wages—salaries—income.

"A survey recently issued by the U. S. Department of Labor shows that the average wage for all American manufacturing establishments is sixty cents an hour, while the corresponding wage in France is twelve cents an hour, in Italy nine cents, and in Japan seven cents an hour.

"The average American worker is the highest paid worker in the world, but he will not be for long if this flooding of the country with cheaply produced foreign merchandise continues; this flood of merchandise that, owing to depreciated currencies, has almost eliminated our tariff protection."

Our Society Affairs

Why does all this concern our Society?

In the first place, the weal and woe of the unemployed members, the lowered salaries of our more fortunate members, the great decrease and, in many cases, total loss of investment incomes, even loss of homes and business due to the economic depression, is a very personal affair for many of our members. We have members who have given years and who have spent large sums of money for scholastic preparation to profitably work in the ceramic industries. Many of them have been employed for several years and have dependent families. By thrift and close application other members have developed manufacturing plants of their own, but without sufficient cash reserves to retain the results of their life work and the investment of their entire material savings.

Many of these members are diligently trying to hold on until business recovers. They know best how to make a living in ceramics. They wish to be kept posted and to be ready when they again have opportunity for employment in ceramics. These ambitious members in distress are being carried on a deferred payment of dues. The Board of Trustees of this Society reasoned that, insofar as it is possible, this credit and these courtesies should be extended.

It is incumbent on your officers and upon you as members to face the economic facts and to consider what we individually and collectively can do to improve the business of our ceramic industries. We must get a perspective of the case in order to know to what extent and for how long we must continue with decreased incomes.

Making Americans Ceramically Conscious

As ceramic technologists, we share with ceramic trade associations the task of making Americans conscious of the high quality of ceramic ware produced in America. To the housewives this applies mostly to clay and glass tableware, and to enamelware for the kitchen and bathroom. To architects this development of favor for ceramic ware relates to brick, structural tile, terra cotta, wall tile, floor tile, and other ceramic construction materials. To highway engineers it is our task to prove the economy and superior serviceability of paving brick. To sanitary engineers this campaign requires the establishment of greater values and durability of clay sewer pipe.

This is not the full list of our tasks in this campaign of making Americans ceramically conscious, but it suffices to show its far-flung field and importance.

Let me enlarge the case of only one ceramic product, that of paving brick, concerning which we should share the task with the National Paving Brick Association in making Americans conscious of the superiority of brick as paving material. I have heard several ceramic men of broad observation and intimate experience with several ceramic products condemn brick for road paving.

A business economy research director rode with me from Columbus to Massillon, Ohio, over Routes 3 and 30 in 1931, before either of these routes had been wholly widened and repaved. We rode over concrete, brick, and macadam, both new and old. When on an old brick stretch with cement bond and insufficient foundation, my friend exclaimed against the ridability of brick paved highways. Before we had reached our destination the ridabilities of the different pavements we rode over proved to him that old concrete roads were rougher riding than old brick paved roads, that concrete roads deteriorated more rapidly, and that the new brick roads were safer and had better ridability than did concrete.

In Chevy Chase, Maryland, on Connecticut Avenue, there are experimental strips of brick pavements which were laid in 1913. Brick from many sources and of widely differing characteristics were used. Except where a heavy fill settled and where the brick joined a concrete paving, that brick pavement has remained in excellent shape under 19 years of heavy traffic of 3000 vehicles per day. On the several sections of the Connecticut Avenue test pavements, according to Dr. A. F. Woods, Director of Scientific Research of the U. S. Department of Agriculture, the maintenance costs have averaged for the 19 years as follows:

Brick	12.65¢ per yard
Asphaltic concrete	17.03¢ " "
Bituminous macadam	51.38¢ " "
Concrete	43.76¢ " "

George F. Fisk, Commissioner of the Department of Public Works, Buffalo, N. Y., compiled the following data from his department records:

MAINTENANCE COST PER SQUARE YARD

	Asphalt	Stone	Brick
1919	0.0860	0.0423	0.0249
1920	.1232	.0648	.0171
1921	.0915	.0493	.0204
1922	.1309	.0138	.0158
1923	.1213	.0384	.0133
1924	.1240	.0340	.0229
1925	.1486	.0448	.0397
1927	.0711	.0056	.0024
1928	.0641	.0128	.0099

The first brick pavement was laid in Charleston, West Virginia, in 1871, and gave satisfactory service for 38 years. There are brick paved streets in many cities that have given satisfactory service for 30 and more years. Summit Street in Columbus is an example.

"Slippery when wet" signs are on all sorts of paved roads. Brick paved roads where too much asphalt filler has been used, especially asphalt not impregnated with grit, are very slippery when wet. When constructed with the wire-cut side of the brick up, and especially when whitewashed before the asphalt filler is applied, the brick pavement is the least slippery of any of the pavements. I have repeatedly demonstrated this to doubters.

Two-course pavements are found by C. A. Hogentogler, Senior Highway Engineer of the U. S. Bureau of Public Roads, to be the most economical, and for the top course brick has a proven superiority.

Brick pavements can be torn up for service pipes and relaid with less expense and with a more even surface than is possible with any other paving material.

All the facts are in favor of brick for highway and street paving. Poorly constructed, inadequately drained, insufficiently bedded, and improperly filled joints produced some wretched brick highway failures in the past. The brick pavement of today is outlasting all other pavements, current prejudices notwithstanding.

We could present similar citations to prove the superior merits of all ceramic products over those of competing nonceramic products. The failures in terra cotta, brick, and other ceramic construction materials are not as numerous or as extensive as with nonceramic products designed for the same purposes, and in most instances these failures have not been due to inherent product faults or insufficiencies. The pottery and glass tableware, the porcelain and glass high-tension insulators, the sanitary ware, in fact all ceramic ware made in America, is inferior to none and superior to most ware made in any other country.

We need to stand shoulder to shoulder in efforts to make Americans ceramically conscious, and conscious, too, of the unexcelled merits of American-made ceramic ware.

Product Development

Our products must serve fully the purposes and conditions of their use. For each purpose we should improve the serviceability of our products and learn those conditions of use which will increase their serviceability. Our products must meet the steadily increasing severe requirement standards.

Product competition is raising the standards of quality and serviceability and lowering the costs per unit of product. Product quality and delivery service will be the basis of competition when our economic affairs are righted. The lower the cost of production, the larger will be the profits. This means an increasing dependence on the science and art of ceramic ware production. These are the tasks that belong peculiarly to this Society, rather than to trade associations.

Ceramists and their corporate employers must, singly and collectively, search for ways and means for maintaining the superior serviceability of our products. Fundamental science research must be employed not alone in our schools but also in our factories. Our technical men must be more thoroughly trained in fundamental science concepts and methods of research. All available information must be classified, recorded, and used. These tasks are essential if we are to keep our ceramic industries fit for business-getting as business recovery progresses. This is the regular and particular task of the American Ceramic Society.

Recovery of normal business will be slow. Product demands commensurate with production capacities will not again be enjoyed until after high shrinkages in values have been absorbed or written off. Of one thing we may be certain, with each passing day additions are being made to our knowledge of how to produce more serviceable ware and how to produce it under better control and at lower costs.

For those who would keep themselves abreast with the latest information there must be an informational collecting, recording, and distributing agency. This your Society is doing by means of the *Ceramic Abstracts*. If we are to be in front as business revives, ceramists must be ever vigilant in seeing to it that this Society has facilities sufficient to render these services.

ACTIVITIES OF THE SOCIETY

LOCAL SECTION NEWS

Pittsburgh Section*

On January 10, 1933, about fifty members of the Pittsburgh Section of the American Ceramic Society met in the Fellows Room of the Mellon Institute of Industrial Research where they were addressed by Donald Ross of the Findlay Clay Products Company.

Mr. Ross discussed briefly the development possibilities of beryllium oxide, zirconia, and other less common oxides for use in glass tanks.

In the aluminum–silica system, experimental work was cited which showed that a fused silica rod suspended in a glass tank and half immersed in the bath was rapidly corroded at the metal line and below it. Corundum as a tank block material was said to present bonding difficulties, and it is the speaker's opinion that the high porosity, possibly inherent in such blocks, would be a disadvantage. Siliceous tank blocks with 10% alumina have shown excellent resistance to corrosion at the metal line, but blocks of this composition are not ordinarily manufactured.

In America, tank-block composition falls into two principal ranges. In one the alumina content is approximately 72% (molten cast mullite blocks) and in the other the silica content is approximately 72%.

In the highly siliceous tank block, the transition layer between glass and refractory is thin. Toward the block side, the transition layer develops mullite crystals which are surrounded by a viscous siliceous glass containing only a small percentage of fluxes derived from the commercial glass. Nephelite is a common crystal component of the transition layer. It was stated that a siliceous block free from structural defects will slowly disseminate into the glass through solution at the transition layer when the concentration of the flux becomes sufficiently high. Low porosity is important since it lowers the rate of solution of the block by the molten glass.

In the mullite type of tank block, the block proper was reported to consist of mullite crystals with a scattering of corundum crystals and a small amount of a highly aluminous refractory glass. In the transition layer there is an increased development of corundum crystals caused by the breaking down of the small mullite crystals. Mullite (predominant) and nephelite are also present.

Mr. Ross mentioned that while the specific gravity of the mullite is about 3.20, that of nephelite is only about 2.6. The question was raised as to whether or not the expansion accompanying the change from mullite to nephelite in the transition layer would be a factor in the breaking away of this type of block. The high viscosity of the more siliceous glass as compared with the low viscosity of the aluminous glass in the 72% alumina blocks was also cited.

Mr. Ross exhibited samples of used tank blocks which showed the development of platy crystals of corundum at the transition layer. These crystals were perhaps as large as $^1/_8$ inch across and they stood out from the glassy coating on the block.

When the meeting was opened for discussion, F. W. Preston stated that he believed that the crystals of corundum and nephelite in the transition layer were not developed while the tank was in service, but that they crystallized on cooling. Mr. Ross has several reasons for believing that this is not the case. One of these is the fact that corundum crystals which appear on the glass side of the transition layer often are found to extend outward from the transition layer as if the surrounding glass had melted and flowed away from them. He does not believe these crystals could have formed unless entirely surrounded by glass.

E. M. Sarraf called the speaker's attention to his statement that corundum formed in the transition layer of the mullite tank blocks and raised the question as to whether or not this indicated the greater stability of corundum and its desirability as a tank block material.

St. Louis Section

The St. Louis Section of the American Ceramic Society visited the Alton Box Board and Paper Co., Alton, Ill., Saturday, February 4, 1933. The revamping of the boiler

* R. E. BIRCH, *Secretary*.

plant with new refractories and complete equipment of control and recording instruments were of special interest to ceramic engineers.

After the plant visit and dinner, the annual election of officers was held at the Alton Country Club.

CERAMIC SCHOOL NOTES

Iowa State College*

The Iowa Clay-Worker's Short Course, held at Iowa State College the third week in January, was attended by fifty-two manufacturers of ceramic materials including one from Kansas, four from Nebraska, one from South Dakota, and one from Minnesota.

The mornings were reserved for papers and the afternoons to the demonstration of a de-airing unit furnished by the Bonnot Co. of Canton, Ohio.

Papers were presented on the following subjects: compression and freezing and thawing test of mortar mix; change from oil to natural gas for a fuel for the continuous kiln; discussion of modern electric equipment for clay plants; slants on drying; development of pug-mill knife construction; comparison of periodic, continuous, and railroad tunnel kilns all in the same plant; firing with coal and other fuels; mechanical stokers for firing kilns; problems in the use of clay products for farm buildings; manufacture of terra cotta by the extrusion machine; forecasting the future trends in heavy clay products.

Twenty-three samples of clay were run through the de-airing unit on the stiff-mud machine, some being short, such as loess clay, and others plastic. Unbalanced dies were used and these were run with and without the vacuum treatment, thus giving conclusive evidence of the assistance of the de-airing unit in forming a good column on this type of die.

Many of those attending the short course had their ware covered with a spray of molten copper and aluminum. This spray gun was a part of the Welder's Short Course which ran simultaneously.

Norton Company's New President

Aldus C. Higgins was elected President and General Manager of the Norton Company at the company's annual meeting January 17, 1933, upon the retirement of Charles L. Allen who has been the only General Manager of that company for forty-seven years and its President since 1919. Although Mr. Allen has retired from executive participation in the affairs of the company, he was elected Chairman of the Board of Directors and will still be in close touch with its business activities.

ALDUS C. HIGGINS

Mr. Allen has been associated with the Norton Company since the incorporation of the old Norton Emery Wheel Company in 1885 and has been the only General Manager the company has had. He was President of the company since 1919 until his recent retirement.

Mr. Higgins is a son of one of the founders of Norton Company and its first president, Milton P. Higgins. He has been associated with the company since 1900, in the early years as Manager of Research Laboratories, Manager of Research and Abrasive Plants, Secretary from 1912 to 1919, and Treasurer and General Counsel from 1919 to 1933.

George N. Jeppson, Vice-President in Charge of Production, was made treasurer to succeed Mr. Higgins. Other officers of the company are Clifford S. Anderson, General Counsel and Secretary; W. LaCoste Neilson, Vice-President and General Sales Manager; Lewis E. Saunders, Manager of Research and Abrasive Plants; Henry Duckworth, Assistant Treasurer and Comptroller; and Clarence W. Daniels, Plants Engineer.

* D. A. MOULTON.

NEW MEMBERS RECEIVED IN DECEMBER, 1932, AND JANUARY, 1933

PERSONAL

Alfred Earl Badger, Research Assistant, Department of Ceramic Engineering, University of Illinois, Urbana, Ill.
John Hugh Chesters, University Club, Urbana, Ill.; Research in Ceramics, Commonwealth Fund Fellowship.
Frank G. Gibson, 211 Ralph Ct. N. W., Canton, Ohio.
Günter Hammen, Gövlitzustr. 11, Bunzlau, Germany.
John D. Morron, 1415 Parker Ave., Detroit, Mich.; Manager, Motor Products Development, U. S. Rubber Co.
Ernest Horace Nichois, Chief Engineer, Funkhouser Co., Hagerstown, Md.
Caleb Parkinson, "Ashdale," Holmfield, Yorks, Halifax, England; Manager and Secretary, Messrs. Parkinson & Spencer, Ltd.
Oscar N. Shaffer, 321 Argonne Drive, New Kensington, Pa.; National Lead & Oil Co.
Leo Shartsis, 1412 Chapin St. N. W., Washington, D. C.; Bureau of Standards.
Nelson Woodsworth Taylor, Professor of Ceramics, Pennsylvania State College, State College, Pa.
Joseph Palin Thorley, Parkway, East Liverpool, Ohio; Art Director, Taylor, Smith & Taylor Co., Chester, W. Va.

STUDENT

University of Illinois, Urbana, Ill.

Wendell P. Keith — **Joseph A. Pask**

Missouri School of Mines and Metallurgy, Rolla, Mo.

Felix Fraulini — **Charles Richard Rosenbaum**

Ohio State University, Columbus, Ohio

Andrew Malinosky, Jr. — **Griffin E. Terry**

Membership Workers' Record

PERSONAL		STUDENT	
A. I. Andrews	1	C. M. Dodd	2
W. N. Harrison	1	C. W. Parmelee	2
C. A. Nicely	1	Office	2
C. W. Parmelee	2		
Fred Sauereisen	1	Total	6
Clement Saxton	1	Grand Total	17
W. F. Steger	1		
Office	3		
Total	11		

ROSTER CHANGES IN DECEMBER, 1932, AND JANUARY, 1933

PERSONAL*

Barger, H. D., Wellsville Fire Brick Co., 1611 E. Erie Ave., Lorain, Ohio. (14702 Superior Rd., Heights Branch, Cleveland, Ohio.)
Berkey, Paul L., 901 Edgewood Ave., Trenton, N. J. (440 S. Atlantic Ave., Pittsburgh, Pa.)
Brown, A. R., 169 Read Ave., Crestwood, N. J. (Ritz Hotel, Pittsburgh, Pa.)
Campbell, Robert M., Trenton Potteries Co., 726 Crown St., Morrisville, Pa. (445 Parkway Ave., Trenton, N. J.)
Cohn, Willi M., 1672 Oxford St., Berkeley, Calif. (1522 Henry St., Alton, Ill.)
Green, Robert S., 1105 S. Jefferson St., Mexico, Mo. (Rolla, Mo.)
Hansard; W. C., 32 Huntingdon Road, Atlanta, Ga. (2 S. Clinton Ave., Trenton, N. J.)
Hasslacher, G. F., Short Hills, N. J. (24 Gramercy Park, New York, N. Y.)
Heffelfinger, G. W., 348 Fleetwood, Coatsville, Pa. (3336 Berea Rd., Cleveland, Ohio.)

* The address within parentheses represents the old address.

Hellmers, Henry T., 417 Sarlen Ave., Clarksburg, W. Va. (909 Beatty Ave., Cambridge, Ohio.)
Hoffman, C. A., British Ceramic Service Co., Ltd., 121 W. George St., Glasgow C-2, Scotland. (15 W. 4th St., Chillicothe, Ohio.)
Keller, W. D., 201 Swallow Hall, University of Missouri, Columbia, Mo. (13 Conant Hall, Cambridge, Mass.)
Kriegel, W. Wurth, Gladding, McBean & Co., Renton, Wash. (15235 Wallingford Ave., Seattle, Wash.)
Longenecker, H. L., Wilson, N. C. (N. J. Clay Products Co., Inc., South River, N. J.)
McDowell, Samuel J., A C Spark Plug Co., Flint, Mich. (175 W. Main St., Newark, Ohio.)
Munshaw, L. M., Crystal Lake, Ill. (Haeger Potteries, Inc., Dundee, Ill.)
Noble, William N., 104 W. Illinois St., Urbana, Ill. (Chicago Vitreous Enameling Co., 1407 S. 55th Court, Cicero, Ill.)
Plank, Ross D., 4135 La Salle Ave., Culver City, Calif. (220 I St. S. E., Auburn, Wash.)
Rugh, E. W., Bolivar, Pa. (431 Winter Ave., New Castle, Pa.)
Shardlow, L. Russel, 112 Sunset Ave., Verona, N. J. (204 Ceramics Bldg., Univ. of Illinois, Urbana, Ill.)
Sladek, G. E., U. S. Quarry Tile Co., Parkersburg, W. Va. (U. S. Encaustic Tile Works, Indianapolis, Ind.)
Spires, Stephen T., 103 Jacoby St., Norristown, Pa. (Lavino Refractories Co., Womelsdorf, Pa.)
Stegmayer, Charles, New City, N. Y. (West Ave., Sewaren, N. J.)
Stowe, G. T., E. J. Lavino Co., 1844 Oliver Bldg., Pittsburgh, Pa. (Bullitt Bldg., Philadelphia, Pa.)
Williams, Francis J., Mineral Industries Bldg., State College, Pa. (69 N. Bryant Ave., Bellevue, Pa.)

NECROLOGY

F. W. Rogers*

"After a long period of illness Frederick White Rogers passed away quietly at his home. He was sixty-six years old. Born at Quincy, Illinois, on September 7, 1866, he spent his early years and youth in that city, where his father, Hiram Rogers, carried on a drug business. After the death of his father, his mother and his uncle conducted a hardware business, where Mr. Rogers made his first acquaintance with the stove and range business. In early manhood he went to Albany, New York, where he learned in detail this line of production in his uncle's stove company. He worked in the factory, then as salesman for the company. Later he was salesman, particularly through the northwest, for the Garland Stove Company and then for the Detroit Jewel Company. In 1902 Mr. Rogers became associated with the newly-formed Malleable Iron Range Company of Beaver Dam, Wisconsin.

"For thirty years his work has been with this company. Since 1921 he has been president of the organization. He has seen the plant grow from one small frame building to a large manufacturing enterprise occupying fourteen acres of floor space, with a capital investment of two million dollars, and with a trade that extends to every continent and to every state of our union.

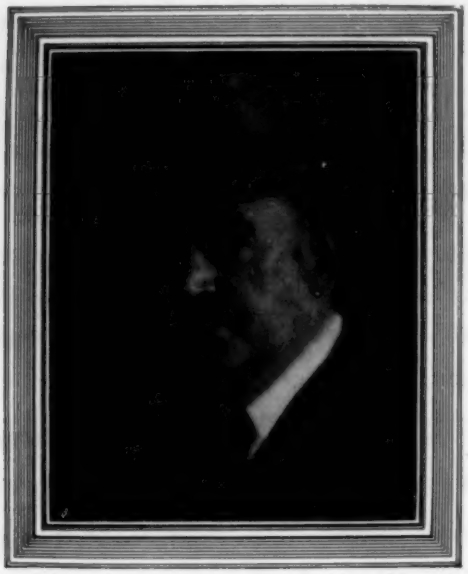
"As was natural, his primary interest in these thirty years has been in the Range Company. He has drawn into the organization a staunch and capable group of coworkers. Every department has been made effective in itself but, over them all, coördinating, giving strength and unity, have been the personality and genius of Mr. Rogers. New inventions and patents, extension of output from coal and wood ranges to include gas and electric ranges, the addition of water heaters and refrigerators to the line of products have come largely from his active, clear-thinking mind. Not a detail of the business in any department escaped his attention and understanding.

"But this organization has been more than a commercial and industrial plant. Its primary interest has been its personnel, not profit. Mr. Rogers has known intimately every worker in the plant.

"Next to his devotion to his industrial enterprise, Mr. Roger's highest interest was in doing good—good to an individual, good to the community. When the foundry of a

* Remarks by Edwin P. Brown at the funeral service, December 21, 1932.

local industrial plant burned a few years ago, before the flames had died down Mr. Rogers found the manager and said, "Bring all your foundry workers up to our plant and carry on there. We can make room for you"—and this though the two plants were in some points in competition.



F. W. ROGERS

"Mr. Rogers had a part in numerous interests of our community. To them he contributed helpfully and wisely. He was director, officer, or both of the Dodge County Fair Association, of the Old National Bank, of the Beaver Dam Building and Loan Association, of the Beaver Dam Loan and Investment Company of Wayland Academy. He never desired place of prominence in these enterprises, but his counsel and his work in each were of inestimable service and value.

"He lived in quietness among us, seeking no praise, no honors. He worked and lived primarily to help other people to be happy. We bow our heads in sadness at his going, in esteem and affection that he has lived among us and that we have known him."

Mr. Rogers, for several years, has been a voting representative of the Malleable Iron Range Co., a corporation member of the American Ceramic Society. His influence and help has been realized. We mourn with his family and business associates the loss of so generous and estimable a co-worker.

W. H. Zimmer

Word has been received of the death on February 2 of Dr. W. H. Zimmer at his home, Waldershof, Bavaria, Germany.

Dr. Zimmer was the first ceramic chemist in this country entitled to that name. He came to Wheeling, West Virginia, in 1888 to take charge of the Ohio Valley China Company in the development of bodies and glazes and to produce china similar to that being produced in Germany. Together with Mr. F. H. Thurn, Dr. Zimmer was practically in charge of the Ohio Valley China Company. They produced ware typical of Germany, especially Dresden, but they had great difficulty in correlating American labor to German principles, and were therefore unsuccessful. The work they did was fully as good as that done by the Germans, but the costs were too great. In 1900 the plant ceased operation.

Dr. Zimmer was then employed as ceramic chemist of the Wheeling Potteries Company where he developed "Cameo" china.

In 1903 he returned to Germany to take charge and become editor of the journal, *Sprechsaal*. Later, he took charge of the Haviland plant at Waldershof.

W. H. ZIMMER

Dr. Zimmer was a charter member of the American Ceramic Society and was a Fellow.

John M. Morton

On January 19, John M. Morton passed suddenly away, his death being caused by heart failure. For many years a member of the American Ceramic Society, he was always ready to do his part and to share the benefit of his experience with others. When our British and French guests were touring this country Mr. Morton gave liberally of his time and money and was a gracious host to our visiting ceramic friends.

At the time of his death John M. Morton was President and General Manager of the Standard Tile Company of Zanesville, Ohio. He commenced work as a mechanical engineer with the B. & O. Railroad. In 1902 he accepted a position with the Mosaic Tile Company and remained with this company until 1923 when he promoted the Standard Tile Company.

Mr. Morton was fifty-six years old at the time of his death and is survived by his wife, one daughter, and two sons, the latter having been associated with him in the Company.

J. M. MORTON

Hermann Hecht

A Testimonial from His Associates*

"It has always been to me a solemn and sincere endeavor to make myself useful and to serve the good cause in every way."

It was on the day of his jubilee, the twenty-fifth anniversary of his activity with the Tonindustrie enterprise, when Hermann Hecht pronounced these words as the confession of his life before his family, friends, representatives, and co-workers. Now, as his career is ended and his words have ceased, let us look back to that hour which was given to us of telling him what he had been to us and in which hour he confessed the purpose of his life. From the illumination and confession of that hour during the turning point of Germany's fateful years, 1918–1919, crowning the festival of his twenty-fifth anniversary, we wish to survey his life which, reaching to a biblical age, has been fertile and blessed and of which he said but a few months before his death that bliss had been his companion. Not undeserved bliss, as he modestly defined it, but a blissful success resting upon the firm foundation of faithful personal activity and his "cause" which found its best and noblest expression in love and concern for his fellow men.

HERMANN HECHT

Life and pursuit—Hecht never separated the two but understood and valued them as a harmonious unity. The devotion to his profession and the pleasure of work with its resulting satisfaction added strength, power, and stimulation to his private life; the inner richness of his life devoted to the sunny side gave always a new impetus to his creative work and helped to overcome worries and difficulties encountered in his professional activity.

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* Translation from *Tonindustrie-Zeitung*, November 21, 1932.

Ceramics was his professional field. The aptitude for it may have come to him from his parents and grandparents who on their landed property in Pommerenia, at Neuhof near Stralsund, not only tilled the soil but also made and fired brick. He was born in 1860, and since the years of his childhood and youth mark the transformation of the brick industry from the hand method of purely empirical principle to a technically and scientifically conducted industry, he may have listened in the home of his parents to many a discourse concerning this transformation, and observed in his father's plant many a technical renovation and transformation. The thought of this scientifically unexplored land may have deepened his inherited inclination for ceramics. Thus, young Hermann Hecht, after graduation from a high school where his favorite subjects, chemistry and physics, were well presented, entered in 1881 the university in Berlin to study natural science as a foundation to ceramics.

The special study of ceramics at that time was still considered strange and new and was offered to him in the chemical research laboratory which Prussia had added to the royal porcelain manufacturing plant in Berlin during 1878. The management of this laboratory was given over to that renowned man of ceramics, Hermann Seger. Young Hecht had the good fortune to become the pupil of this man.

That day in 1884 on which he began to work in ceramics under Seger determined definitely the direction and goal of his life and connected him permanently with ceramics and later with Seger's life work, the Tonindustrie institution.

As a young doctor in 1886, Hecht became Seger's assistant and in 1890 Seger's successor, while but 30 years of age, when Seger withdrew from the research laboratory to enter upon his own venture. Three years later Seger's untimely death created a vacancy in his Tonindustrie enterprise and again Hecht was chosen as his successor, becoming in conjunction with his colleague, Cramer, the proprietor of the firm. Just as Seger during his best years kept his position with the research laboratory so also did Hecht until 1897. At this time he also became assistant to the Patent Office and continued this activity until the end of 1899 when he received the title of government councillor.

As with Seger, a twofold activity was no longer possible. The constantly expanding Tonindustrie enterprise demanded the full measure of his personality and activity. Years of ascent followed in succession for the enterprise and its two leaders, Cramer and Hecht, also years of hard intensive work. Upon Hecht rested the management and organization of the many-sided enterprise. But these duties did not deter him from his most important tasks, research and literature, which brought him the full recognition of his profession. His scientific writings, the books which he published and with which he assisted, are fundamental in ceramics and have helped materially in the bridging from empirical to scientific ceramics. We need to draw attention only to Seger's Collected Writings, to "Clay Ware" in Musprall's Chemistry, to the revision of Kerl's Handbuch der gesammten Tonwarenindustrie (Handbook of the clayworking industries), to his assistance on "Singer," and above all his own Lehrbuch der Keramik (textbook of ceramics), now in the second edition. The comprehensive section "Clay Ware" in the 10th volume of the Encyklopädie der technischen Chemie (Encyclopedia of technical chemistry), which had its second edition during this year, was Hecht's last large work.

Of the periodicals published by the Tonindustrie enterprise, Hecht always considered *Keramische Rundschau*, which embraces the field of fine ceramics, as his most personal field of activity. He was its editor from 1909 to his death and editor of the *Tonindustrie-Zeitung* since 1926.

With every problem he attacked and every office he accepted, it was Hecht's firm aim to continue in the spirit and tradition of Seger. The example of Seger also caused him to seek expression in the field of teaching and in 1897 he was private instructor at the University in Charlottenburg and founded there the chair of ceramics. It is characteristic of him to consider himself not alone as the giver but also as the receiver who in contact with youth could carry away pleasure and refreshment and who on many excursions to ceramic plants knew how to bind more firmly his own relations with those of the newcomers in ceramics.

These important relations with the industry he continued to foster through his close contact within the professional organizations. Among them ranks first the German Ceramic Society for the industries of clay, cement, and lime, at that time a large association embracing the industries of stone, rock, and earthy materials, of which he was the secretary for over twenty-five years and in which he advanced their interests by many lectures. He received the honorary membership of this Society as well as of its successor, the Reichsverband, of the German clay and brick industry.

Hecht furthermore was for many years a member of the board of trustees of the

German Association for Pyro-Technology which honored him also with honorary membership. He was the vice-president of the Dutch Tile Association until his death. He was a member of the board of trustees of the German Ceramic Society for many years. During the last years of his life he was connected with the committee on standardization for fireproof building materials and chairman of the sub-committees on standardization of forming, testing, and grading.

The year 1914, which revolutionized every life and work, placed Hecht as part owner and co-worker of an important and world-renowned enterprise before difficult and trying problems.

He knew before his death that the enterprise would be continued under the old tradition by men he had brought up himself, men who had stood by him during the most difficult times of Germany's economic distress, who are now called upon to guide the destinies of the firm, Dr. Hirsch and Dr. Hans Hecht, who entered the firm on the twenty-fifth anniversary of his father. This day, which brought him so much love, esteem, and recognition, and the fiftieth anniversary of the Tonindustrie enterprise eight years later have been noted events in his career. Another noted event occurred last year when the German Museum in Munich bestowed upon him the ring of the Museum in recognition and appreciation of his assistance in establishing the Museum branch of fine ceramics. Finally, on September 25, 1932, the German Ceramic Society conferred on him its highest award for scientific achievement in ceramics, the Seger medal, thus linking once more his name with the name of Seger whose life work he had been destined to maintain and to extend.

Hecht was greatly devoted to his enterprise and to his work, yet he also possessed the gift of fully enjoying the better things of life, mainly beauty. Beautification of life he found in nature, in his beloved mountains, and in art. These beauties unquestionably deepened his devotion to ceramics, and this taste for beauty and art explains why he was drawn closer and closer to fine ceramics which is an expression of free and applied art. It was always a delight to him to hold in his hands a truely graceful receptacle, to look upon or feel a beautiful glaze, to study in collections and exhibitions the various creations of ceramics, and to follow the transformation of style and substance. His greatest pleasure was to add a beautiful specimen to his own collection or to point out and explain to a visitor the treasures of his collection.

Music was another companion to him. To hear and to execute music was to him a necessity.

When the days of his vacation arrived, it was only nature in the great out-of-doors which could satisfy his longing for beauty. As a product of the plains of northern Germany whose soil is bordered by the sea, he had a strong longing for the mountains, for his beloved Alps. He roamed there in every direction, climbed its peaks, absorbed in his heart the wonders and beauties of its valleys and hills, taught his children and grandchildren on such journeys the marvels of nature, its geology and flora, and the characteristics and customs of the people. Hermann Hecht made great efforts to serve his beloved mountains as president of one of the branches of the German and Austrian Alpine associations, and he spread the gospel of his mountain love into far-flung circles. Always he returned home from the hills rejuvenated and refreshed with a new zeal and strength for his work.

Thus was the cycle of his life: from work through weeks with art and nature back again to his work. Now he has relinquished his cycle. The room of our house which is still filled with reminiscences of work, of thoughts, wishes, and cares of an activity of 40 years is empty, that room which held his guiding spirit in the form of a kind, just, and noble man who was as straight as his stature to the end of his life.

Everyone, whether in low or high position, has lost a guide and friend, and in every heart his passing leaves a void and a feeling of deep sorrow. Yet we must not reflect in memory with gloom for it would not be to his liking. We can not honor him higher and revere his memory in our hearts more fitting and more beautifully than to live up to his motto, "to make ourselves useful and serve the good cause in every way."

NOTES AND NEWS

INDUSTRIAL RESEARCH LABORATORIES

The Research Information Service of the National Research Council is preparing a revision of its bulletin, "Industrial Research Laboratories of the United States, including Consulting Research Laboratories," the fourth edition of which was published in 1931 and contained over 1600 such laboratories.

This bulletin is the only list of industrial research laboratories known to the compilers (Clarence J. West and Callie Hull) and is undoubtedly used by many persons, not only as a source of information concerning such laboratories but also as a mailing list for important announcements concerning new apparatus and processes and for compilations of interest to research workers in industrial fields.

In addition to the 1600 laboratories already known, it is desirable that additional laboratories be listed. While every effort will be made to locate such firms, many will be overlooked unless they are called to the attention of the compilers.

If the reader of this note is a member of a firm maintaining a research laboratory and if it is not known whether the firm in question is already listed in the previous bulletin, it is hoped that a request will be forwarded immediately to the Research Information Service, National Research Council, Washington, D. C., requesting a questionnaire, in order that the forthcoming bulletin may be made as complete as possible. The listing involves no financial obligations on the part of any firm and may be of considerable value, since this publication is recognized by all familiar with it as a valuable source of information regarding industrial research activities in the United States.

The data included in the bulletin are made up of the name and address of the firms, the research directors, and the research problems engaging the attention of the laboratories. An alphabetical list of research directors, a subject index of research interests, and a geographical index of firms are also included.

The bulletin will not be available for distribution before September, 1933.

HOME OWNERSHIP, INCOME, AND TYPES OF DWELLINGS

Each of the committees of the President's Conference on Home Building and Home Ownership has been concerned with some phase of the problem of home ownership. It has been definitely stated throughout the Conference that the purpose of this phase was to make home ownership possible for families who desire to own their own homes and to protect them in such ownership from needlessly heavy burdens of financing, taxation, and legal difficulties. The Committee on Home Ownership and Leasing limited its studies largely to an examination of the advantages of home ownership, the conditions under which it is desirable, the relative merits, economic and social, of ownership and renting and considered the interests of the lending agency and the public as well as those of the prospective home owner. This Committee was under the chairmanship of Ernest T. Trigg.

The report of the Committee on the Relationship of Income and the Home, whose Chairman was Professor Niles Carpenter, Chairman of Department of Sociology, University of Buffalo, is a useful and thought-provoking study of contemporary income data in its relation to housing. It also includes a section on low-cost housing projects.

The Committee on Types of Dwellings in its report classifies and defines the varieties and types of dwellings. Studies of trends in residential construction, of the relative merits and costs of the prevalent types of houses, and of the effect of land value upon the various types were also made by this committee under the chairmanship of John Ihlder, Executive Director of the Pittsburgh Housing Association.

The findings and recommendations of these three committees presented in this volume will be of particular value to all specialists in housing and social welfare as well as to realtors, subdividers and contractors, architects, home economists, present and prospective householders, and to public servants who deal with any phase of the housing problem.

I. Home Ownership and Leasing

Appendices

Home Ownership and the Business Cycle
Safeguarding the Home Investment
Problems of Renting

II. Relationship of Income and the Home

General Considerations and Recommendations

Recent Data on Income Distribution and Family Expenditures for Housing in the United States
Low-Cost Housing Projects
The Buffalo Home Ownership Study
A Case Study of Ten Home-Purchasing Families in the Buffalo Area
Proportion of Homes Owned and Rented by Valuation Classes in 1930

Appendix

Supplementary Recommendations on Reconditioning, Remodeling, and Modernizing

III. Types of Dwellings

Appendices

Family Types and Housing Trends
Land Value and Its Effect upon Types of Dwellings
Diagrams and Descriptions of Types and Varieties of Dwellings

Publications of the President's Conference on Home Building and Home Ownership

The final reports of the Committees were edited by John M. Gries and James Ford.

(1) Planning for Residential Districts
(2) Home Finance and Taxation
(3) Slums, Large-Scale Housing, and Decentralization
(4) Home Ownership, Income, and Types of Dwellings
(5) House Design, Construction, and Equipment
(6) Negro Housing
(7) Farm and Village Housing
(8) Housing and the Community. Home Repair and Remodeling
(9) Household Management and Kitchens
(10) Homemaking, Home Furnishing, and Information Services
(11) Housing Objectives and Programs

Each of these volumes is priced at $1.15 (foreign $1.25), postage prepaid.
A special price of $10.50 (foreign $11.00), postage prepaid, will be made for the complete set of eleven volumes. Checks should be made payable to James Ford, Editor, and orders should be sent to the President's Conference on Home Building and Home Ownership, New Commerce Building, Washington, D. C.

HAVE YOU HEARD THE LIKE OF THIS BEFORE? DO NOT CERAMISTS HAVE THIS SAME PROBLEM?

The Steel Industry's Greatest Problem

By John F. Kelly*

The loss of markets through economic conditions and the inroads of competing materials have aroused the steel industry to serious consideration of its distribution problem.

The campaign to promote new uses for steel is the contribution of the Association of Iron and Steel Electrical Engineers to the steel industry's greatest problem. In this effort, workers, regardless of position, are being urged to search for new possibilities and report them to the Association of Iron and Steel Electrical Engineers through the Association members who are expected to head up the campaign activities in their respective plants. Prizes have been offered and will be awarded shortly after the close of the movement on May 15 on the basis of the practicability, utility, and economic use of the product suggested by a committee of leaders in the industry.

In the past prosperous years, the steel industry has had as its motto: "Greater Tonnages, Reduced Costs." It has achieved this objective and the resulting benefits have been passed on to the consumer.

* Managing Director of the Association of Iron and Steel Electrical Engineers.

To secure greater tonnages, the industry built larger blast furnaces, larger size open hearths, heavier and heavier mills. To reduce costs, steel manufacturers purchased the latest and most modern equipment; they electrified their plants, they organized and re-organized their operating personnel; they cut wastes; they worked night and day within their plants upon improvements to produce more steel at less cost.

The steel industry did all these things, but they neglected to use the same energy, the same foresight outside the plant that they had used inside. They overlooked the need to educate the population of the United States in the uses of steel. In the main, they disregarded the development of new markets, new outlets for steel. They lived in the belief that the consumption of steel would, without help or assistance, grow in proportion to the population and to the expansion of other lines of endeavor. In this belief they were mistaken because they apparently did not consider the extension of activities of other industries with other competitive materials. Bridges were built of concrete, roofs were built of tile and slate, and now structural aluminum beams are being considered as a substitute for steel. In the substitution of some other materials for steel, it is obvious that utility of the material has been sacrificed for ornamentation.

The steel industry is equipped to produce 71,000,000 ingot tons and its distribution forces are not organized to market this tonnage. The situation demands speedy and intelligent action and a reorganization of distribution departments on the same intensive scale used in rebuilding production departments. The production problem, generally speaking, is well on its way to solution, and the industry's efforts should now be turned to its greatest task—distribution. Briefly, methods of distribution that existed in the past must be scrapped and distribution organized under scientific and engineering lines that will produce "Demand Appeal" for steel.

Realizing that one should never tear down what he can not build better and that the industry's present need is greater distribution, the Association of Iron and Steel Electrical Engineers is sponsoring a campaign to develop new uses for steel, the success of which depends upon the activities of not only Association members, who represent an aggressive constructive group in the industry, but also all others of the great army of steel workers, regardless of position.

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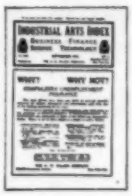

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	Page
American Potash & Chemical Corp.	5
American Telephone & Telegraph Co.	4
Ceramic Color & Chemical Mfg. Co.	5
Chicago Vitreous Enamel Product Co.	13
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Edgar Plastic Kaolin Co.	2
Exolon Co.	6
Ferro Enamel Corp.	5
Hammill & Gillespie, Inc.	14
Journal of the Society of Glass Technology	2
Kentucky-Tennessee Clay Co.	1
McDanel Refractory Porcelain Co.	12
Metal & Thermit Corp.	Outside Back Cover
Norton Co.	1
Pacific Coast Borax Co.	9
Paper Makers Importing Co.	6
Philadelphia Quartz Co.	13
Porcelain Enamel & Mfg. Co.	14
Potters Supply Co.	14
Professional Directory	13
Roessler & Hasslacher Chemical Co.	Inside Back Cover
Spinks, H. C., Clay Co.	13
Tables Annuells de Constantes & Donnees Numeriques	9
Vitro Mfg. Co.	2
Wilson, H. W., Co.	9

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